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Experiment 4: 2D DFT of an Image

Aim:- To apply 2D DFT on the given input.

Apparatus: PC/Laptop, MATLAB Software and few Images

Theory: An image is spatially varying function $f(x,y)$. For analyzing spatial variations, one way is to decompose an image in to set of orthogonal functions (fourier functions). Since we decompose the image into base functions, instead of transmitting or storing the entire signal we can concentrate on confined based functions. Other advantages of this transform are based on storing, transmitting and even for another function for further operations. Thus, a fourier transform is used to transform an intensity image in to the domain of spatial frequency.

2D Fourier (discrete time) Transform (DTFT)

$$F(u,v) = \sum_{m=-\infty}^{\infty} \sum_{n=-\infty}^{\infty} f[m,n] e^{-j2\pi(um+vn)}$$

2D Discrete Fourier Transform (DFT)

$$F[k,l] = \frac{1}{MN} \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} f[m,n] \cdot e^{-j2\pi\left(\frac{k}{M}m + \frac{l}{N}n\right)}$$

Fourier transform of a 2D signal defined over a discrete finite grid of size MXN. 2D DFT is a self-consistent transform and can be considered as a mean of calculating the transform of a 2D sampled signal defined over a discrete grid. The signal is periodized along both the dimentions and the 2D DFT can be

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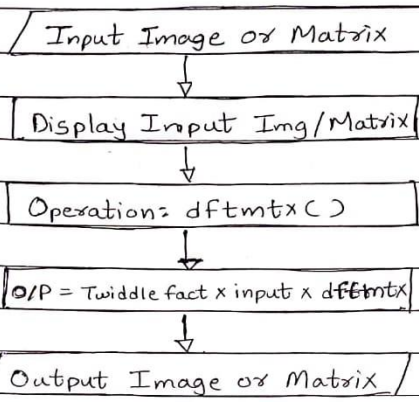
regarded as a sampled version of the 2D DFT.

Flowchart & Algorithm:-



The input matrix or image which we call at first is stored in a variable. Further we can display our input based on our choise. Further we make a 4x4 dft matrix and store it in a variable. For output, we create another variable and store the product of input and dft matrix and twiddle factor. Further we can display the output using the pre existing functions

Coding and Output:

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2DDFT.m

```
1 -  input_image = [1 1 1 1; 1 1 1 1; 1 1 1 1; 1 1 1 1];
2 -  display(input_image);
3 -  kernel=dftmtx(4);
4 -  output=kernel*input_image*[kernel];
5 -  display(output);
6
```

Command Window

```
input_image =

     1     1     1     1
     1     1     1     1
     1     1     1     1
     1     1     1     1


output =

    16     0     0     0
     0     0     0     0
     0     0     0     0
     0     0     0     0

>> 2*D_DFT.m2*D_DFT.m2*D_DFT.m2*D_DFT
```

Conclusion: Thus I conclude that I have studied, understood and performed the experiment based on 2D DFT