Laporan Tugas 2
Interpretasi dan Pengolahan Citra

Disusun oleh:
13519008 Ronggur Mahendra

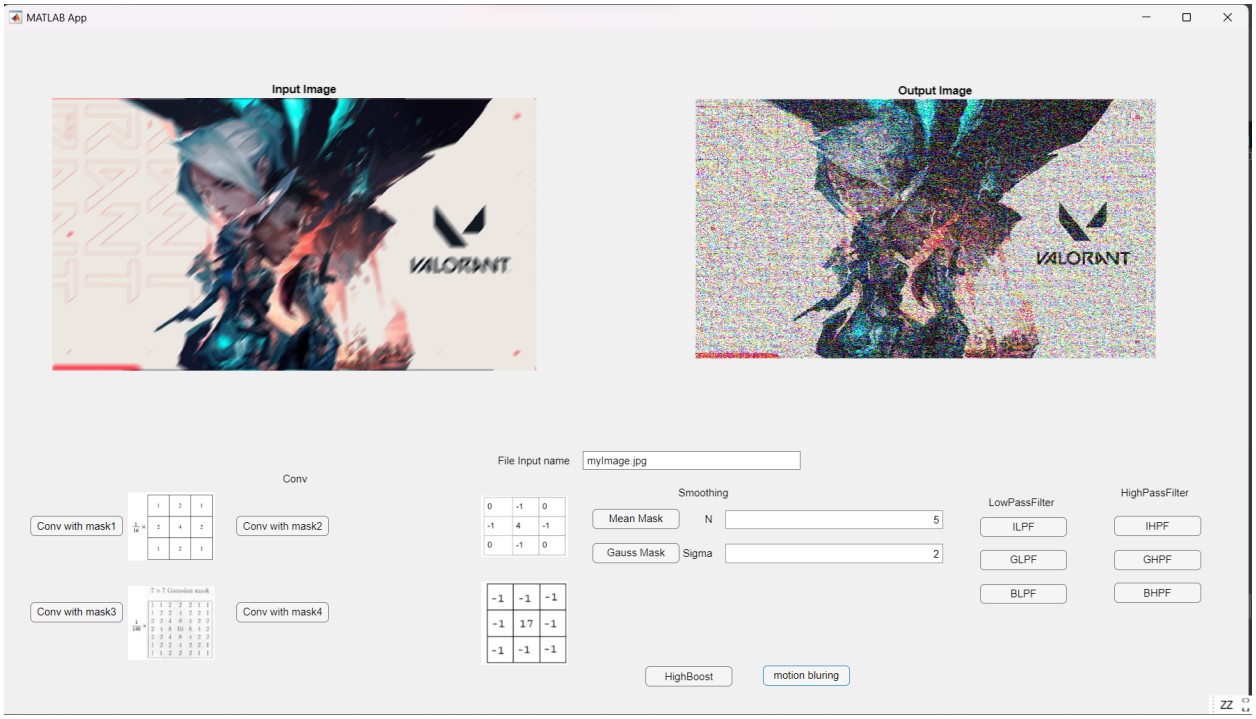
PROGRAM STUDI TEKNIK INFORMATIKA

SEKOLAH TEKNIK ELEKTRO DAN INFORMATIKA

INSTITUT TEKNOLOGI BANDUNG

2023

1. Screenshot GUI



2. Program

a. Konvolusi

i. Kode Program

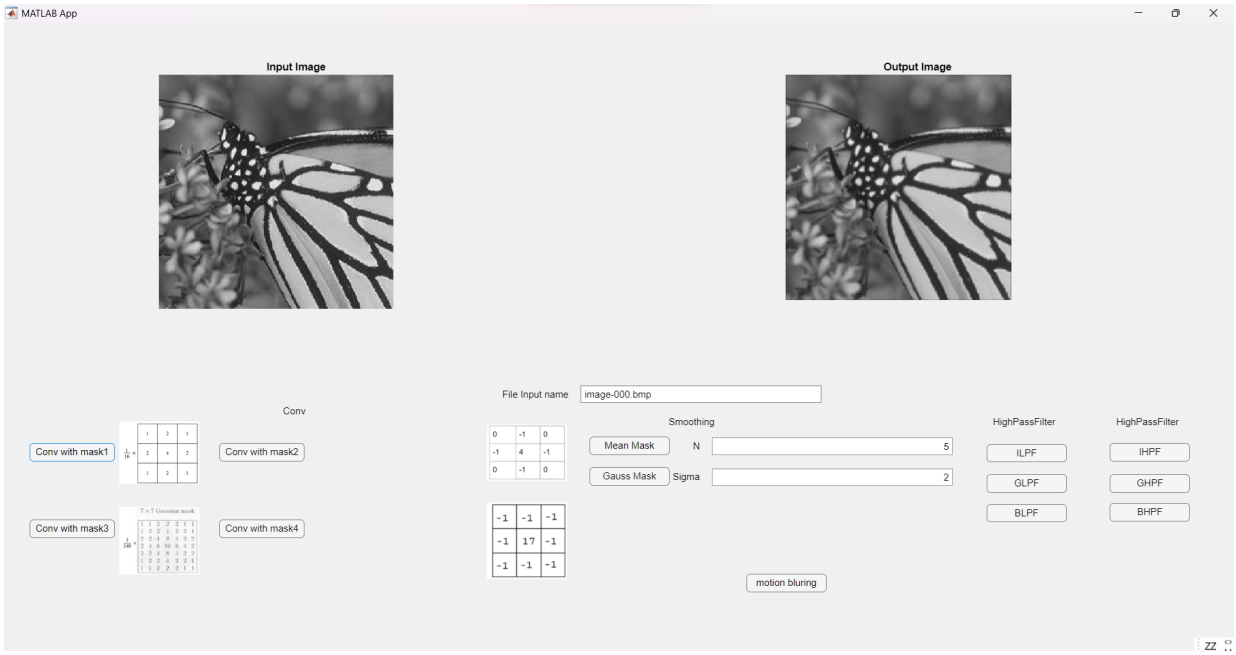
```
% Button pushed function: Convwithmask2Button
function Convwithmask2ButtonPushed(app, event)
    filename = app.FileInputnameEditField.Value
    img_input = imread(filename);
    imshow(img_input, 'Parent', app.UIAxes);
    % mask1 = [1/16 2/16 1/16 ; 2/16 4/16 2/16 ; 1/16 2/16 1/16];
    mask1 = [1 2 1 ; 2 4 2 ; 1 2 1]/16;
    mask2 = [0 -1 0 ; -1 4 -1 ; 0 -1 0];
    mask3 = [1 1 2 2 2 1 1 ; 1 2 2 4 2 2 1 ; 2 2 4 8 4 2 2 ; 2 4 8 16 8 4 2 ; 2 2 4 8 4 2 2 ; 1 2 2 4 2 2 1 ; 1 1 2 2 2 1 1] / 140 ;
    mask4 = [ -1 -1 -1 ; -1 17 -1 ; -1 -1 -1];
    img_result = uint8(my_rgb_conv(double(img_input), mask2));
    imshow(img_result, 'Parent', app.UIAxes_2);

    function result = my_rgb_conv(image, mask)
        [m, n, ~] = size(image);  % Get the dimensions and ignore the third dimension (color channels)
        [p, q] = size(mask);
        pad = floor((p - 1) / 2); % Padding
        result = zeros(m, n, 3);  % Initialize result for three color channels
        imagePadded = padarray(image, [pad, pad], 0, 'both');

        for c = 1:3
            for i = 1:m
                for j = 1:n
                    region = imagePadded(i:i+p-1, j:j+q-1, c);

                    % Melakukan konvolusi
                    result(i, j, c) = sum(sum(region .* mask));
                end
            end
        end
    end
end
```

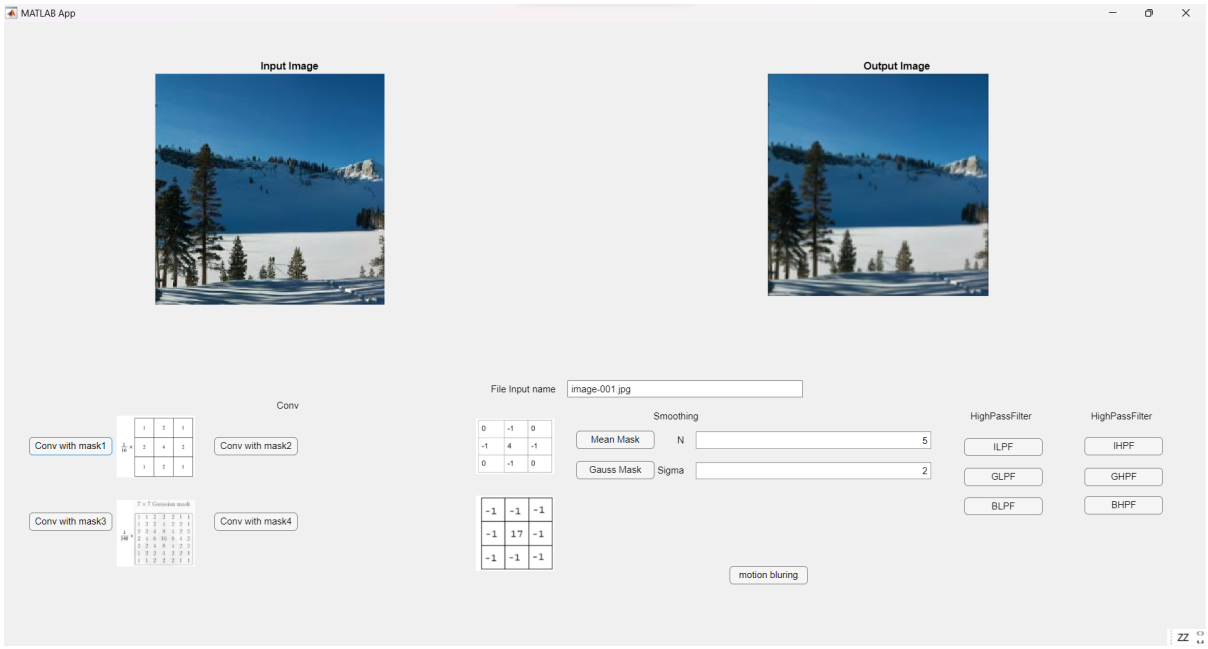
Cat : dengan parameter masukan disesuaikan dengan tombol pada GUI

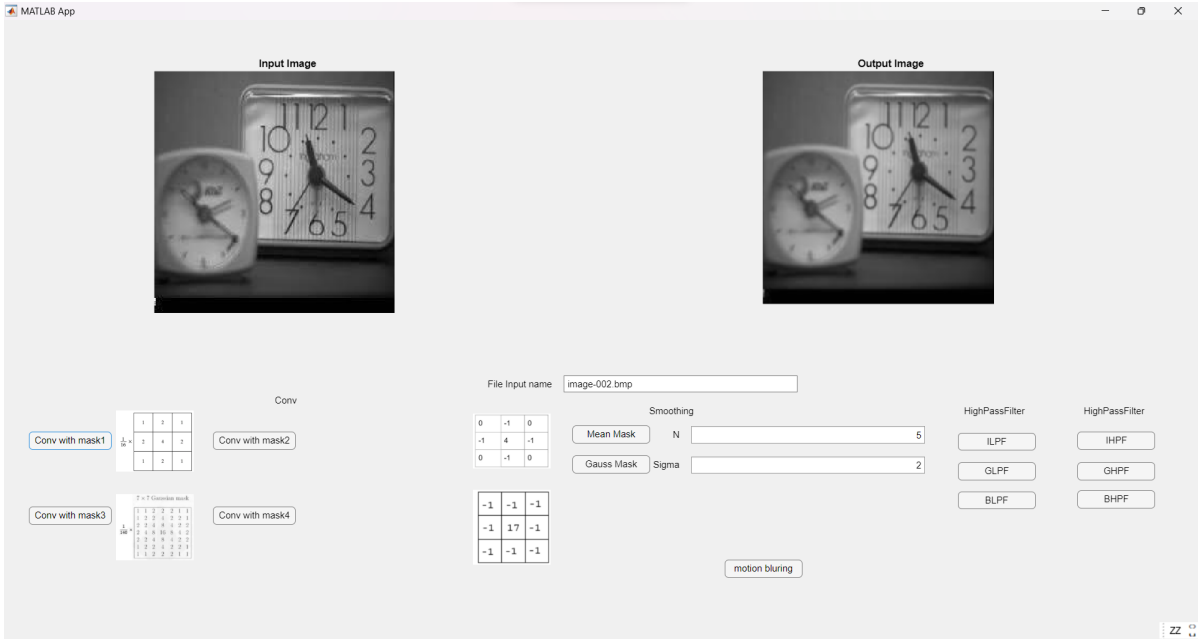
ii. Hasil Eksekusi

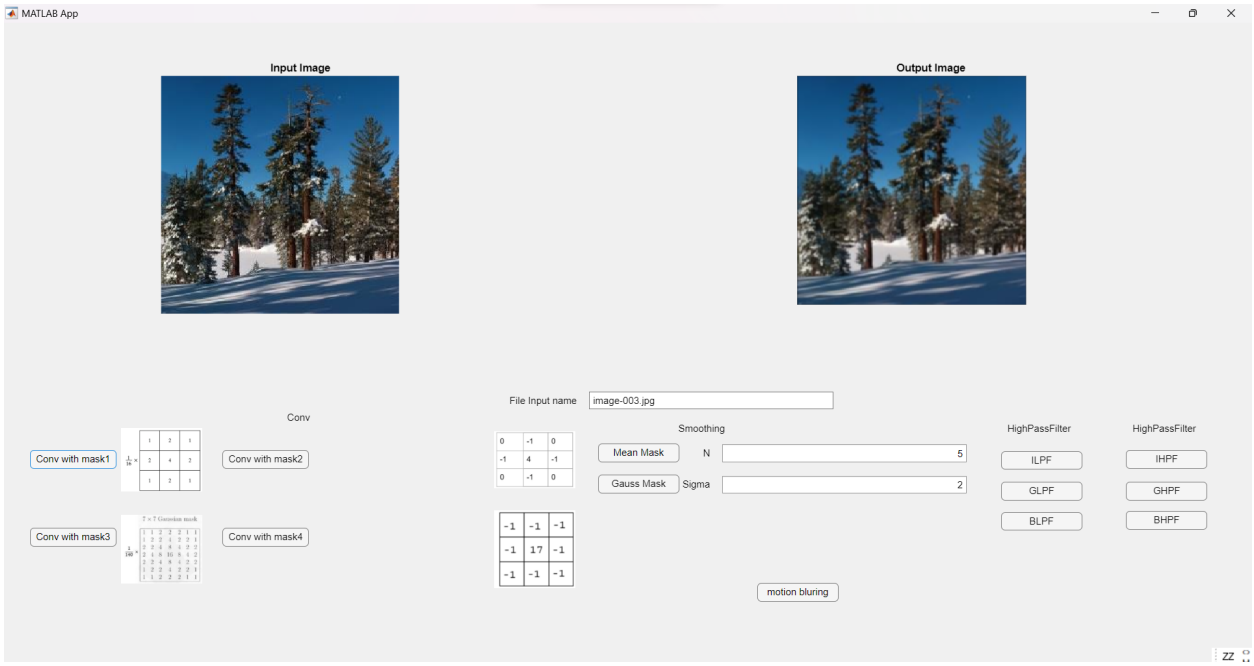
1. Mask 1

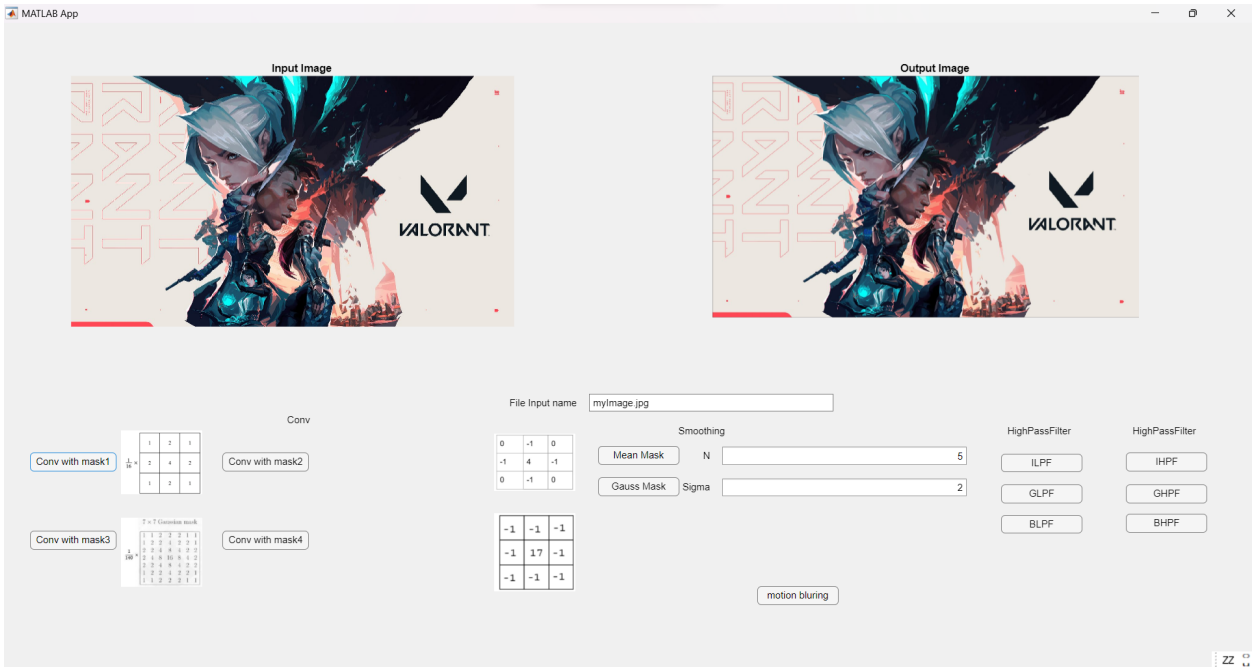
$$\frac{1}{16} \times \begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$$

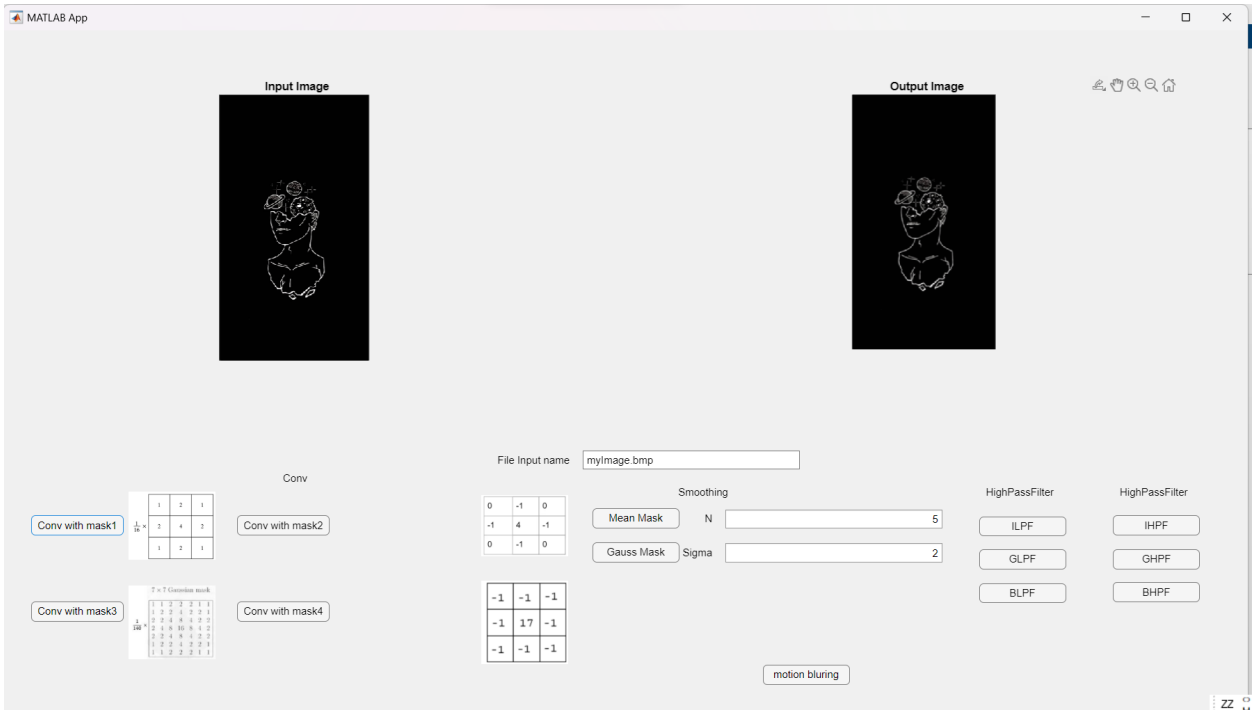



MATLAB App
Input Image
Output Image
File Input name
image-001.jpg
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Mean Mask
N
5
ILPF
IHPF
Gauss Mask
Sigma
2
GLPF
GHPF
Conv with mask3
Conv with mask4
BLPF
BHPF
motion bluring


MATLAB App
Input Image
Output Image
File Input name
image-002.bmp
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Mean Mask
N
5
ILPF
IHPF
Gauss Mask
Sigma
2
GLPF
GHPF
Conv with mask3
Conv with mask4
BLPF
BHPF
motion bluring

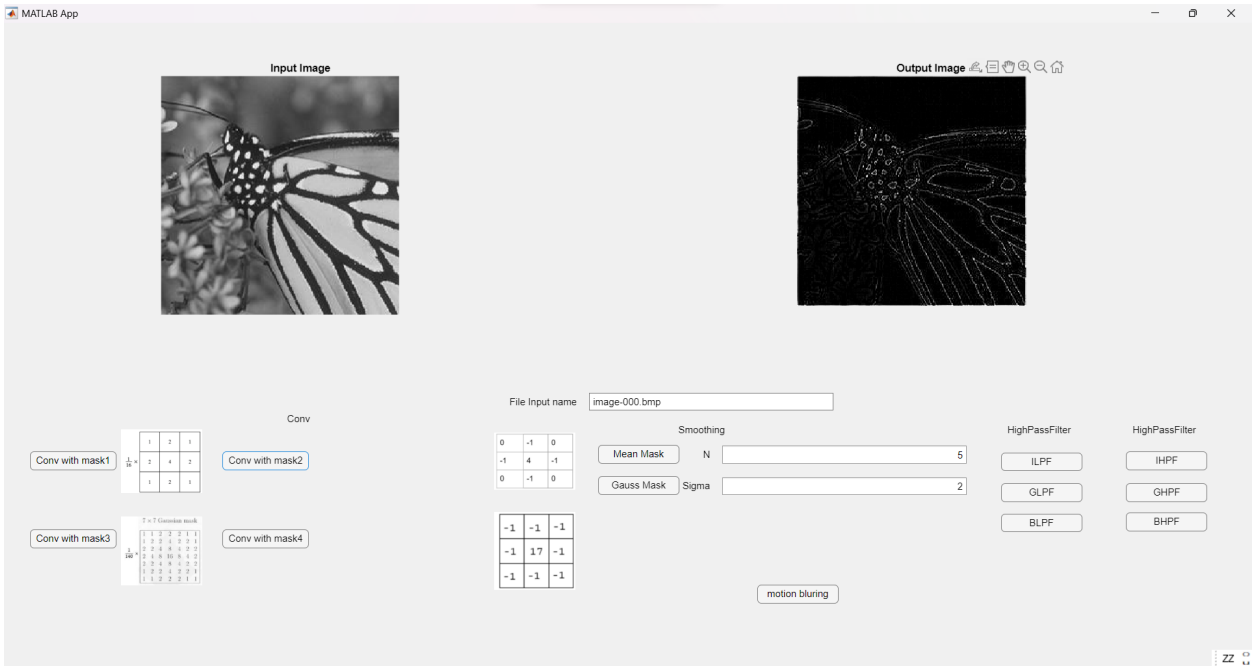

MATLAB App
Input Image
Output Image
File Input name
image-003.jpg
Conv
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Smoothing
Mean Mask
N
5
Gauss Mask
Sigma
2
HighPassFilter
ILPF
GLPF
BLPF
HighPassFilter
IHPF
GHPF
BHPF
motion bluring

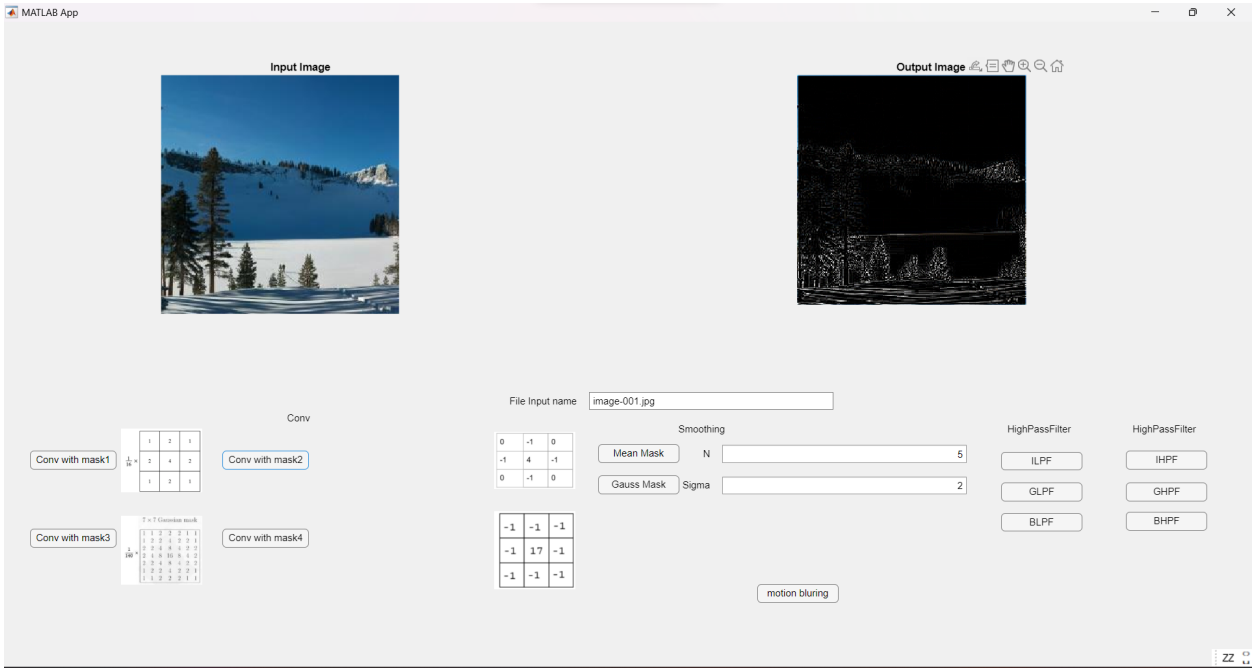

MATLAB App
Input Image
Output Image
File Input name
myImage.jpg
Conv
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Smoothing
Mean Mask
N
5
Gauss Mask
Sigma
2
HighPassFilter
ILPF
GLPF
BLPF
HighPassFilter
IHPF
GHPF
BHPF
motion bluring

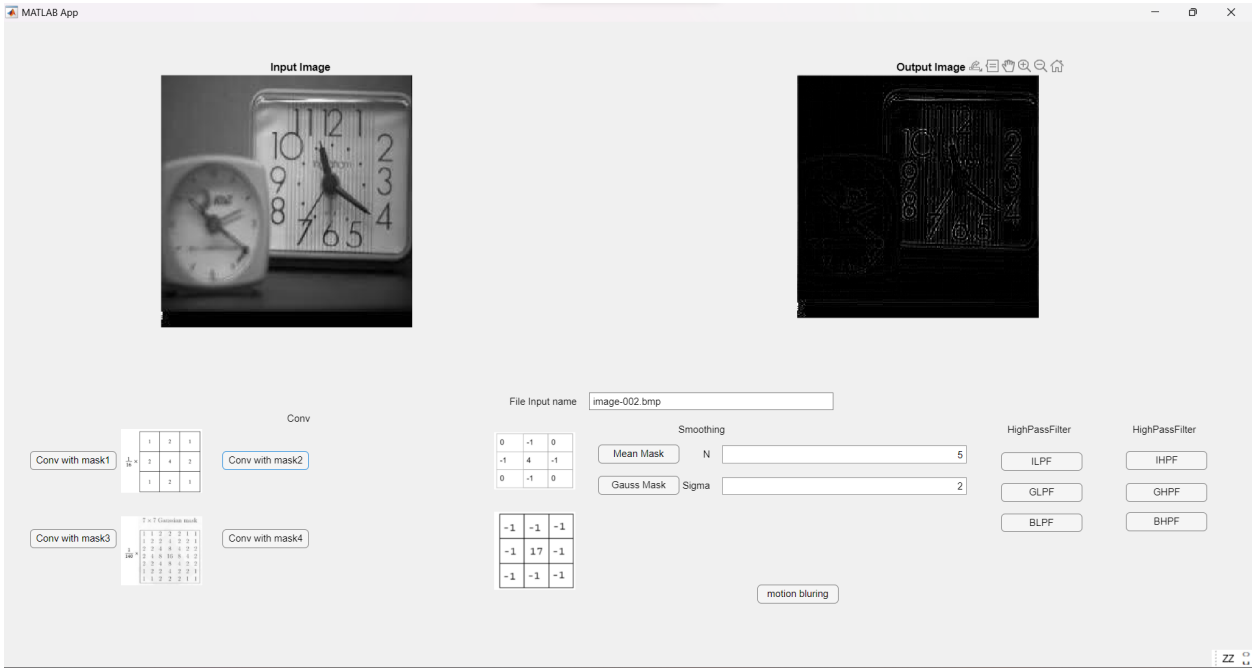


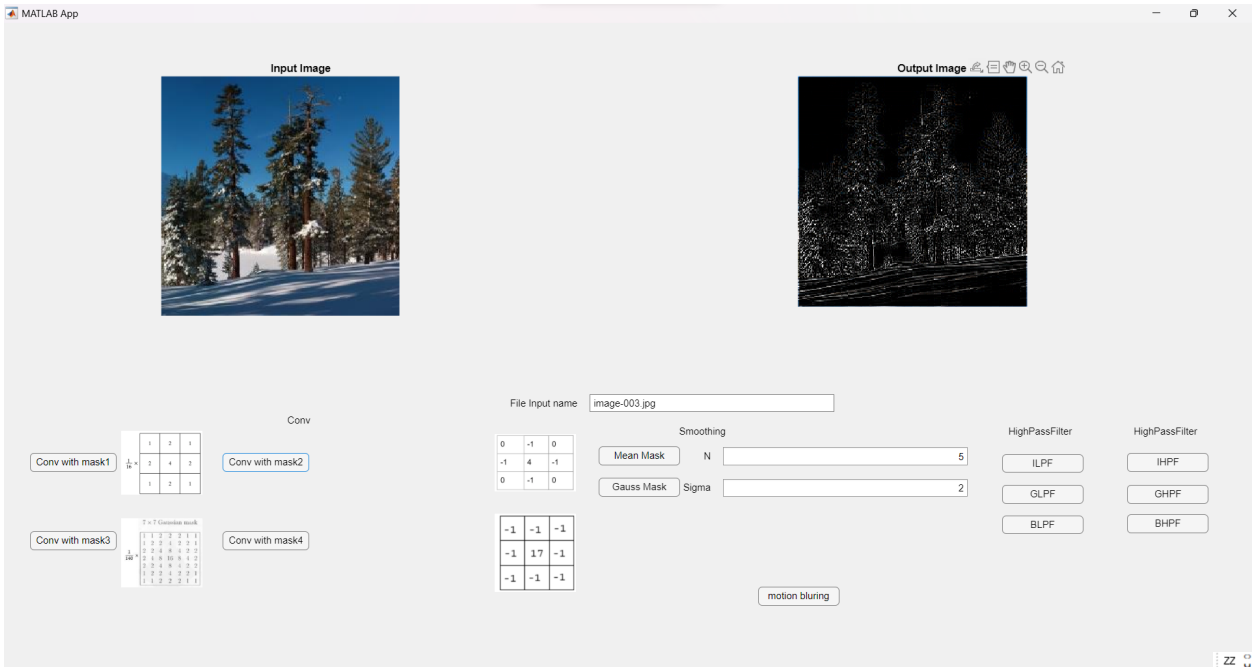
2. Mask 2

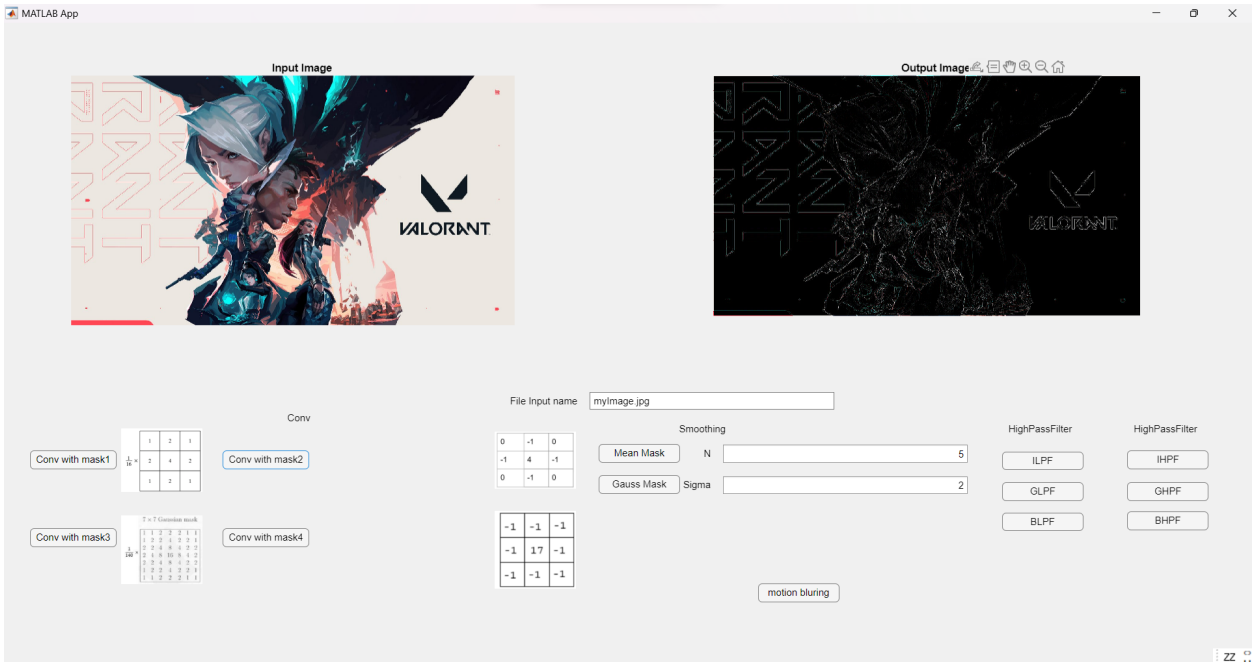
0	-1	0
-1	4	-1
0	-1	0

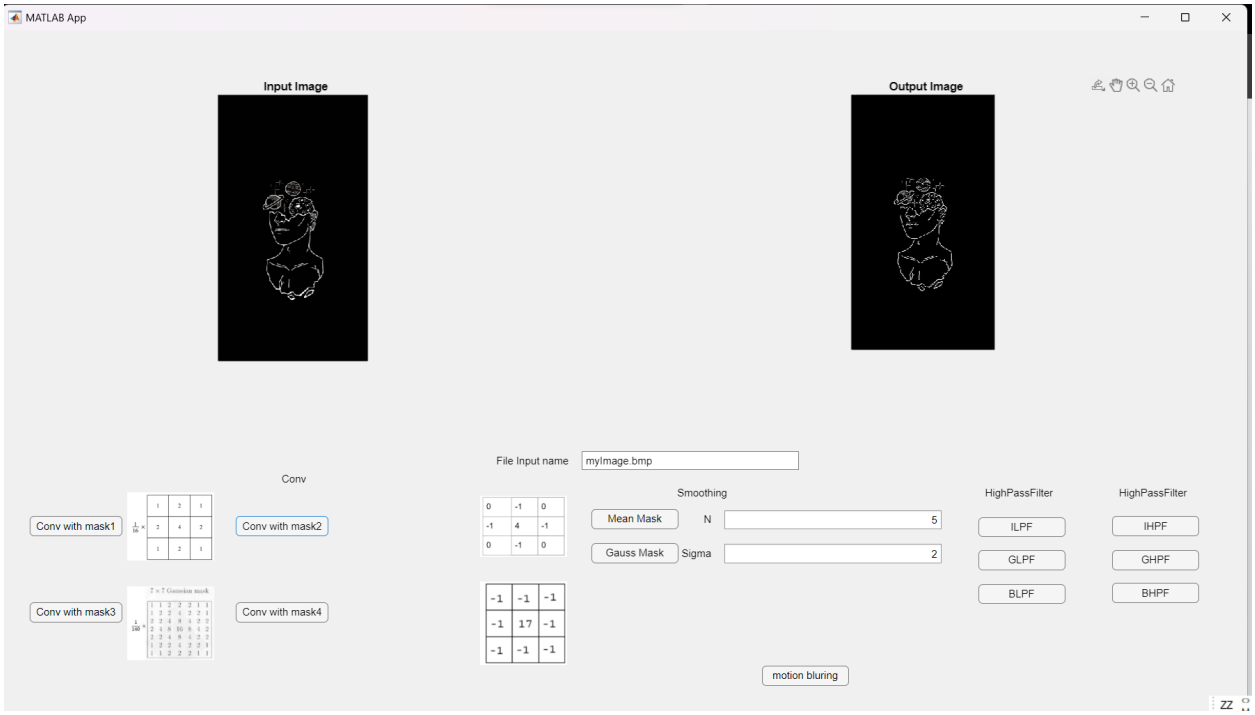

MATLAB App
Input Image
Output Image
File Input name
image-000.bmp
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Mean Mask
N
5
Gauss Mask
Sigma
2
ILPF
IHPF
GLPF
GHPF
BLPF
BHPF
motion bluring


MATLAB App
Input Image
Output Image
File Input name
image-001.jpg
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Mean Mask
N
5
Gauss Mask
Sigma
2
ILPF
IHPF
GLPF
GHPF
BLPF
BHPF
motion bluring


MATLAB App
Input Image
Output Image
File Input name
image-002.bmp
Conv
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Smoothing
Mean Mask
N
5
Gauss Mask
Sigma
2
HighPassFilter
ILPF
GLPF
BLPF
HighPassFilter
IHPF
GHPF
BHPF
motion bluring


MATLAB App
Input Image
Output Image
File Input name
image-003.jpg
Conv
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Smoothing
Mean Mask
N
5
Gauss Mask
Sigma
2
HighPassFilter
ILPF
GLPF
BLPF
HighPassFilter
IHPF
GHPF
BHPF
motion bluring

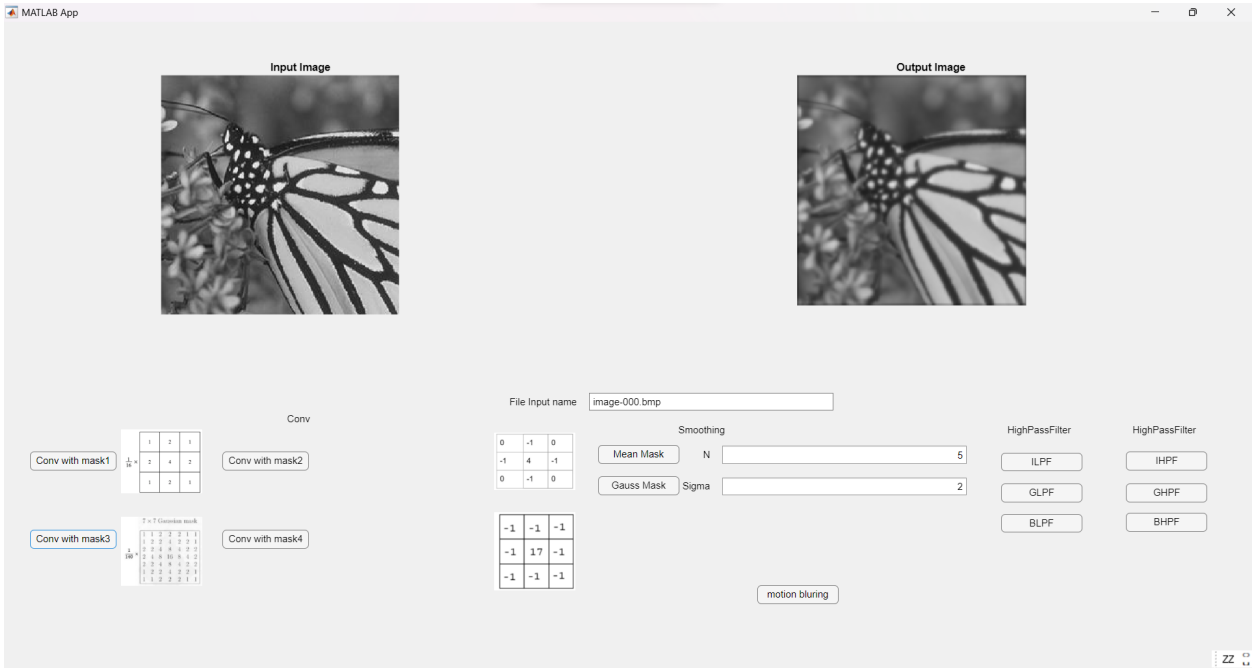

MATLAB App
Input Image
Output Image
Conv
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
File Input name
myImage.jpg
Smoothing
Mean Mask
N
5
Gauss Mask
Sigma
2
HighPassFilter
ILPF
GLPF
BLPF
HighPassFilter
IHPF
GHPF
BHPF
motion bluring

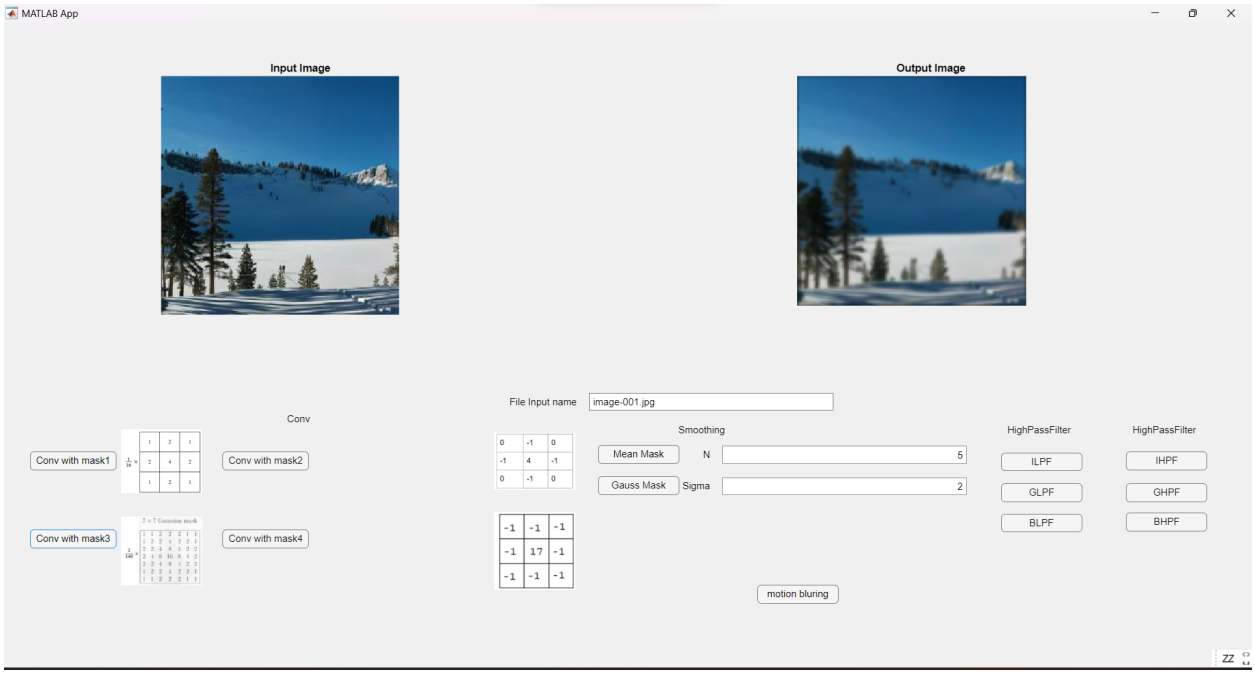

MATLAB App
Input Image
Output Image
Conv
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
File Input name
myImage.bmp
Smoothing
Mean Mask
N
5
Gauss Mask
Sigma
2
HighPassFilter
ILPF
GLPF
BLPF
HighPassFilter
IHPF
GHPF
BHPF
motion bluring

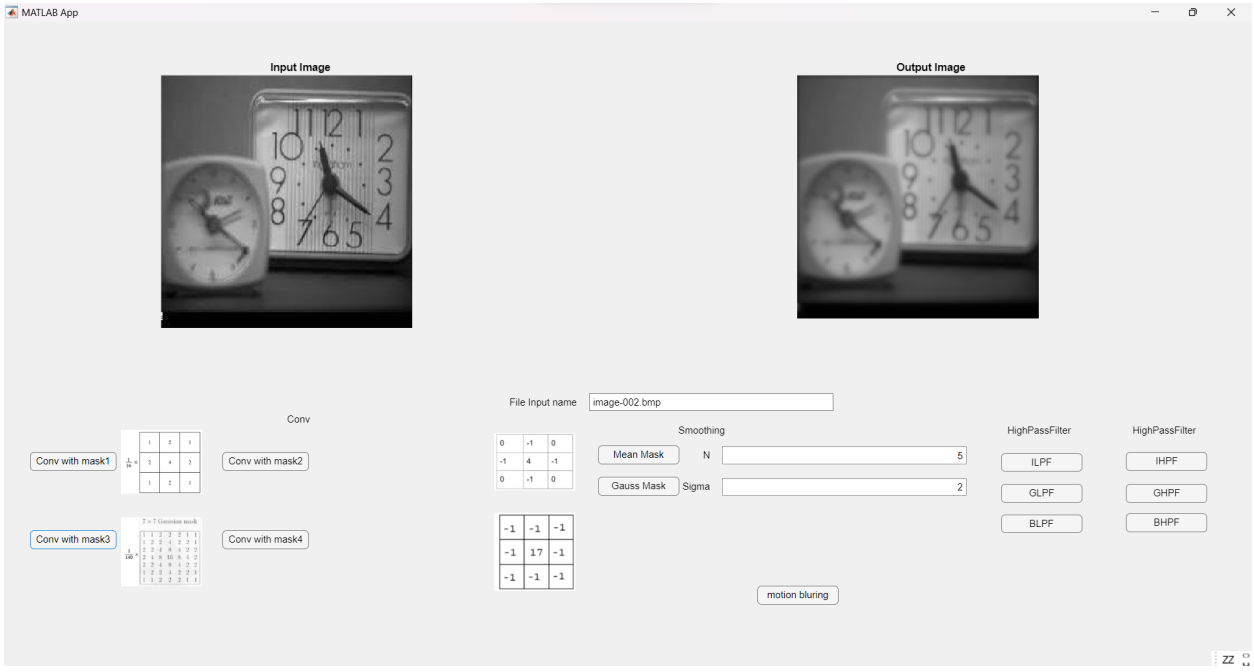
3. Mask 3

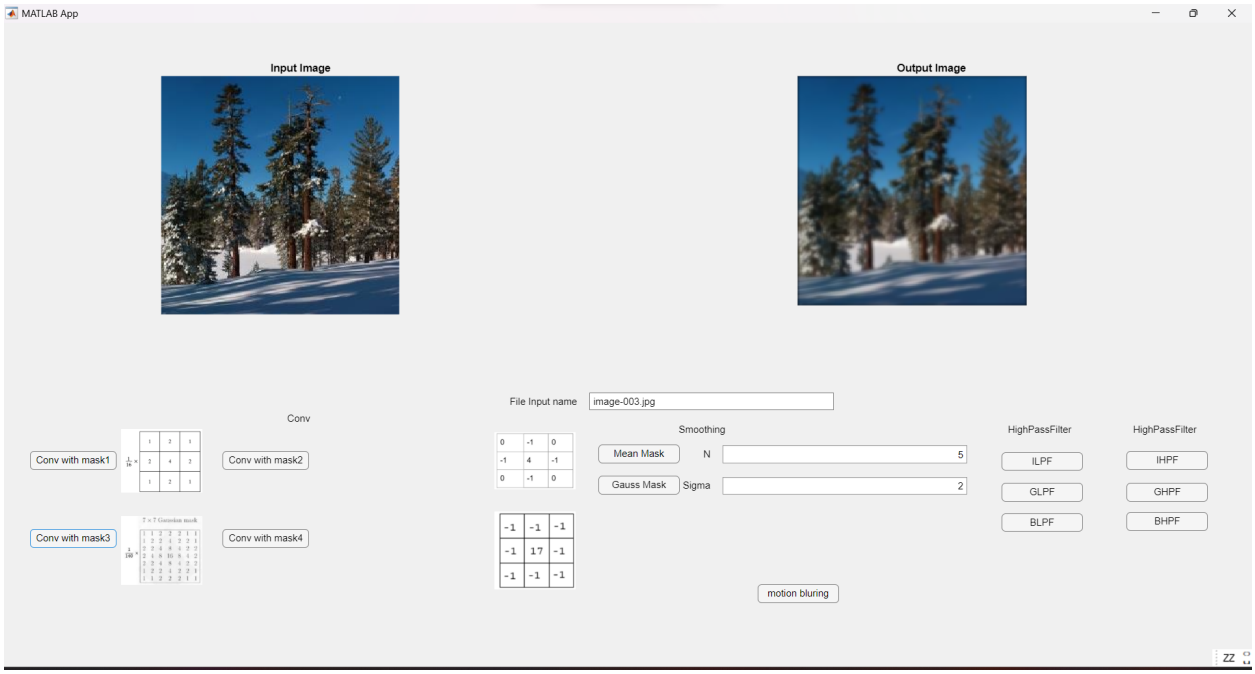
7×7 Gaussian mask

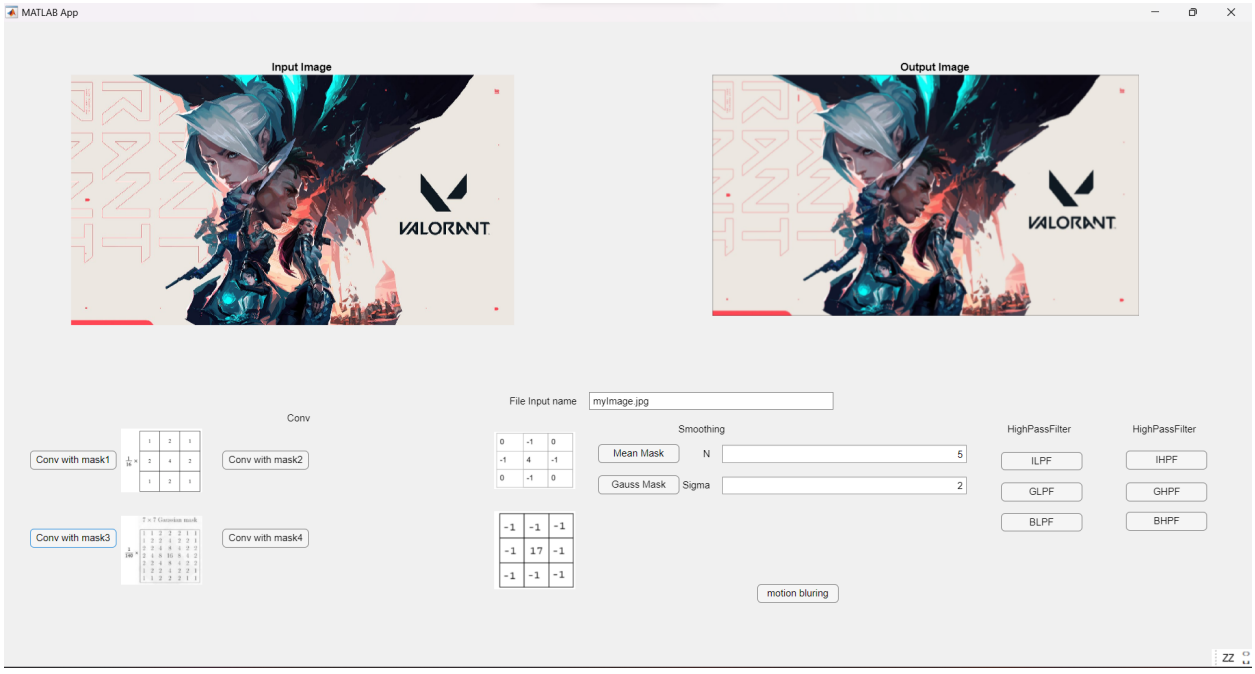
$$\frac{1}{140} \times \begin{bmatrix} 1 & 1 & 2 & 2 & 2 & 1 & 1 \\ 1 & 2 & 2 & 4 & 2 & 2 & 1 \\ 2 & 2 & 4 & 8 & 4 & 2 & 2 \\ 2 & 4 & 8 & 16 & 8 & 4 & 2 \\ 2 & 2 & 4 & 8 & 4 & 2 & 2 \\ 1 & 2 & 2 & 4 & 2 & 2 & 1 \\ 1 & 1 & 2 & 2 & 2 & 1 & 1 \end{bmatrix}$$

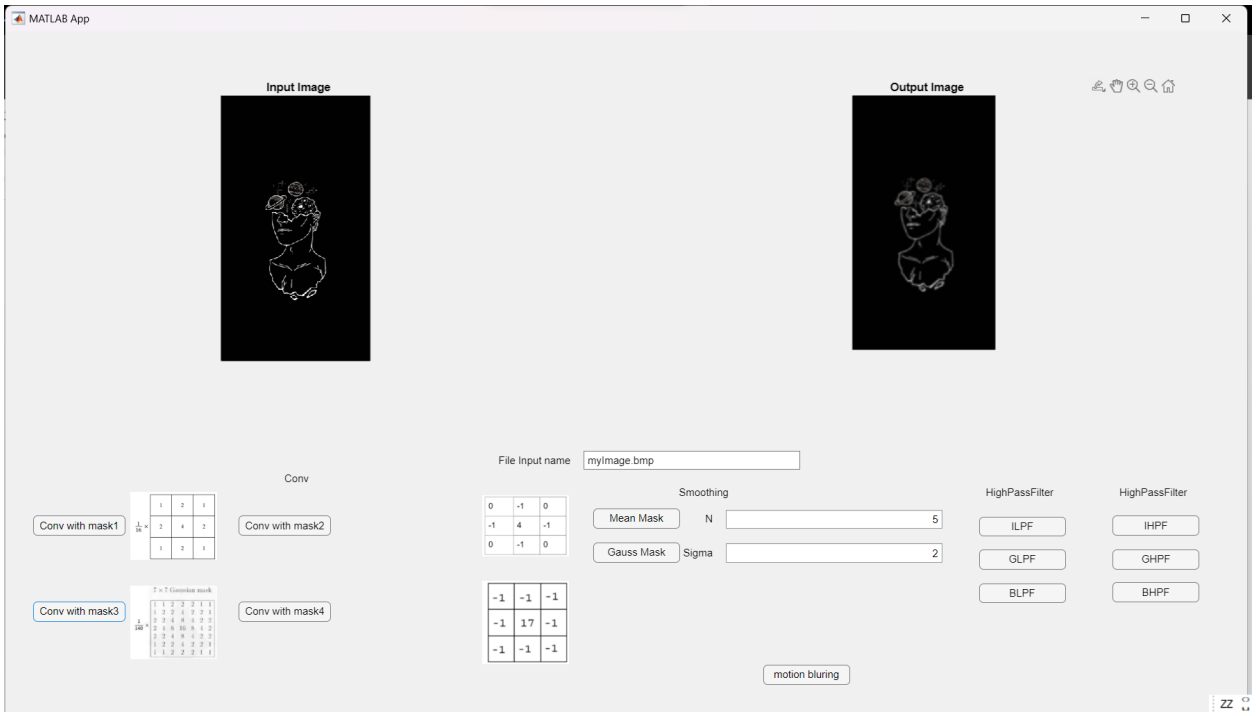



MATLAB App
Input Image
Output Image
File Input name
image-001.jpg
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Mean Mask
N
5
ILPF
IHPF
Gauss Mask
Sigma
2
GLPF
GHPF
Conv with mask3
Conv with mask4
BLPF
BHPF
motion bluring


MATLAB App
Input Image
Output Image
File Input name
image-002.bmp
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Mean Mask
N
5
ILPF
IHPF
Gauss Mask
Sigma
2
GLPF
GHPF
Conv with mask3
Conv with mask4
BLPF
BHPF
motion bluring

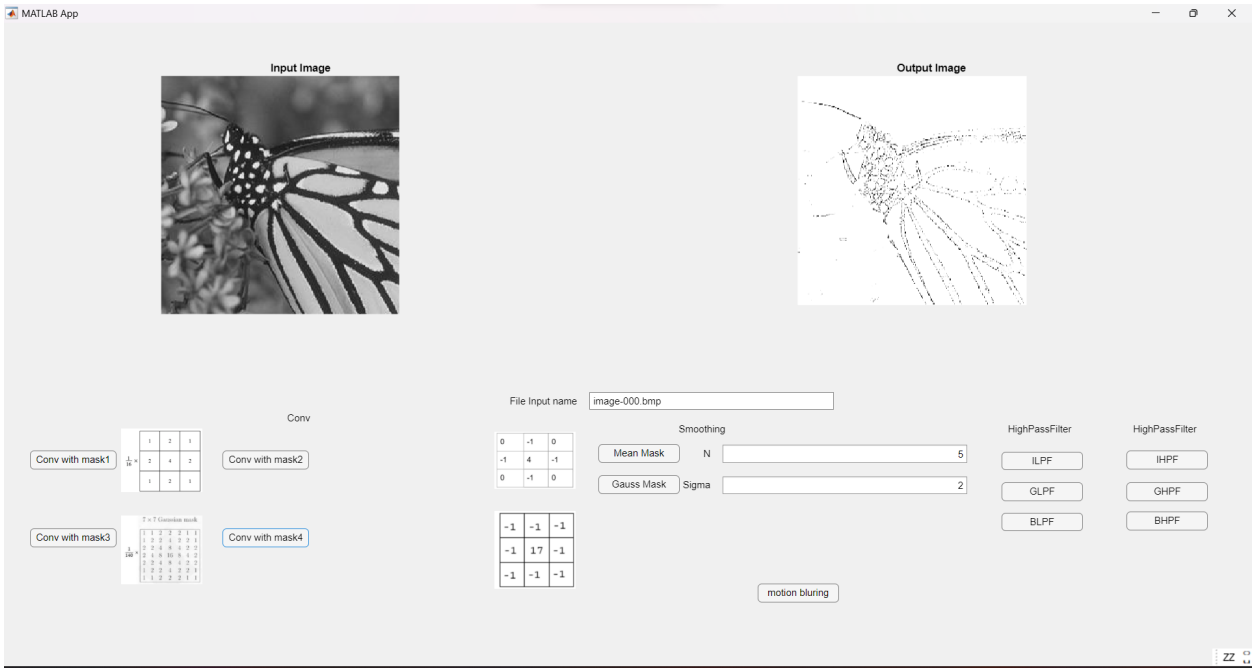

MATLAB App
Input Image
Output Image
File Input name
image-003.jpg
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Mean Mask
N
5
ILPF
IHPF
Gauss Mask
Sigma
2
GLPF
GHPF
Conv with mask3
Conv with mask4
BLPF
BHPF
motion bluring

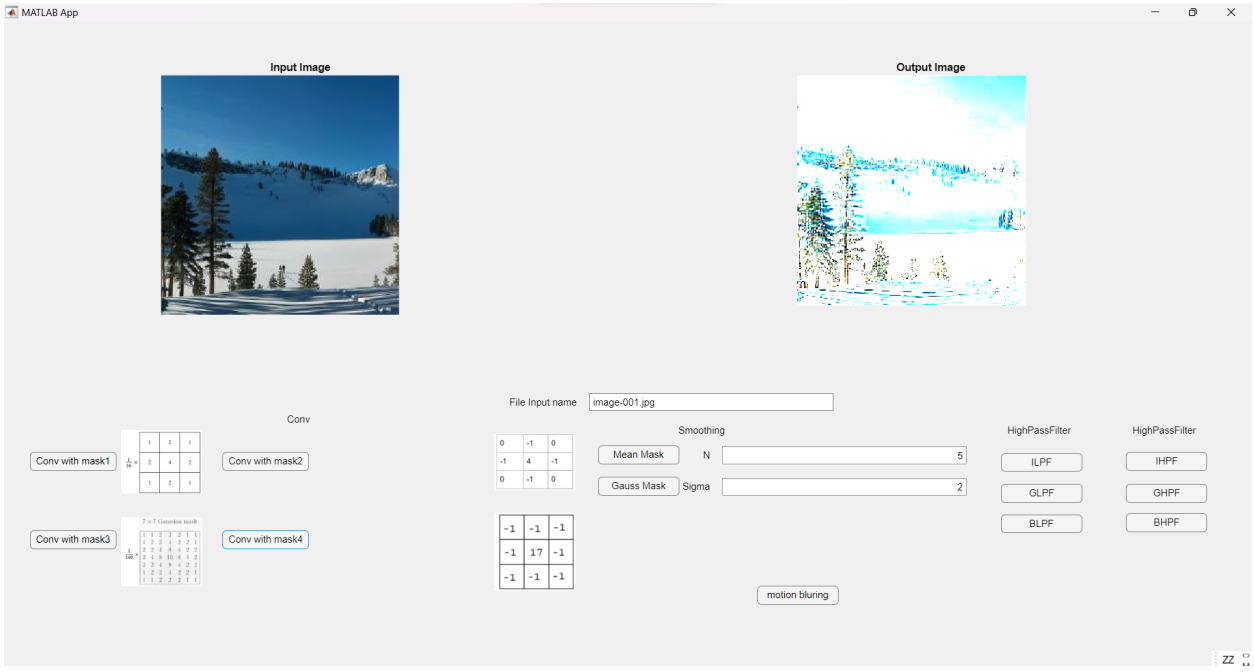

MATLAB App
Input Image
Output Image
VALORANT
File Input name
myImage.jpg
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Mean Mask
N
5
ILPF
IHPF
Gauss Mask
Sigma
2
GLPF
GHPF
Conv with mask3
Conv with mask4
BLPF
BHPF
motion bluring

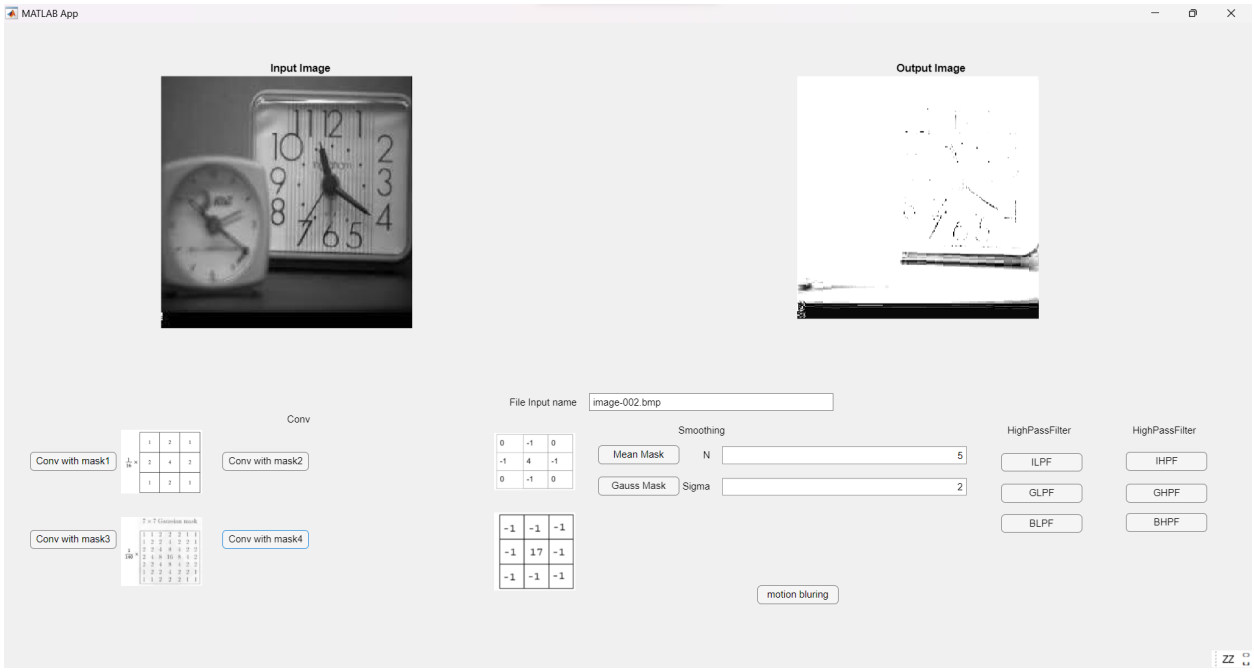


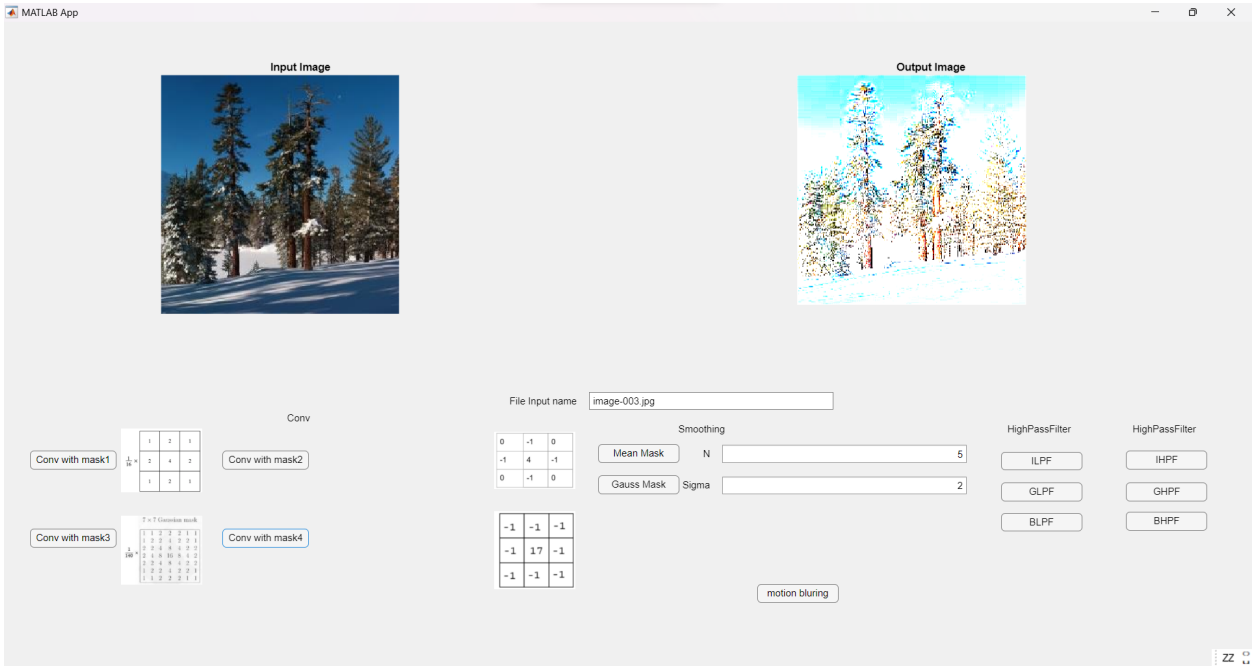
4. Mask 4

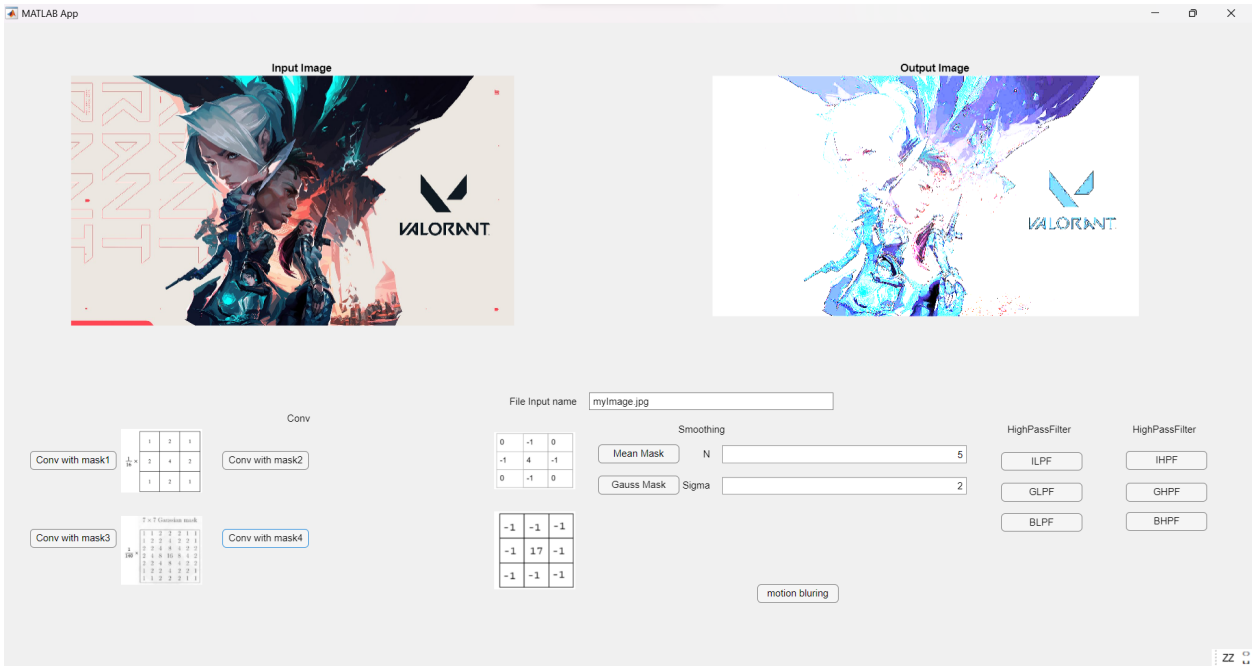
-1	-1	-1
-1	17	-1
-1	-1	-1

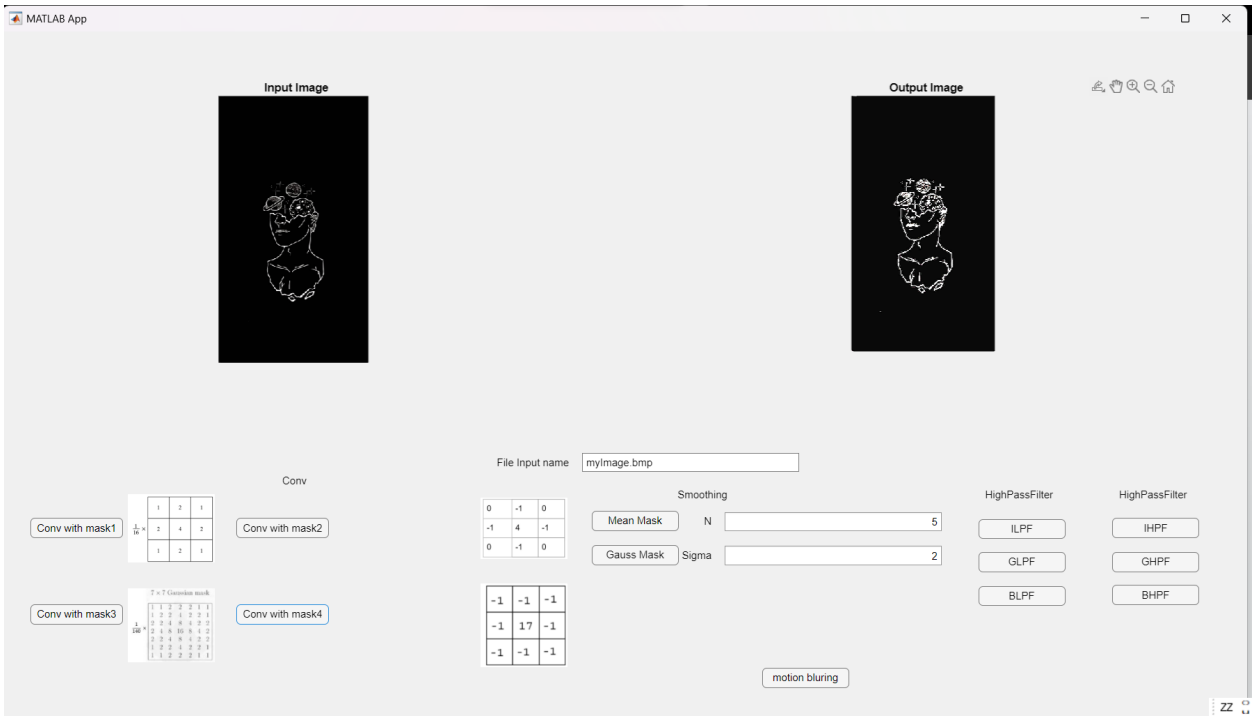

MATLAB App
Input Image
Output Image
File Input name
image-000.bmp
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Mean Mask
N
5
ILPF
IHPF
Gauss Mask
Sigma
2
GLPF
GHPF
Conv with mask3
Conv with mask4
BLPF
BHPF
motion bluring


MATLAB App
Input Image
Output Image
File Input name
image-001.jpg
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Mean Mask
N
5
ILPF
IHPF
Gauss Mask
Sigma
2
GLPF
GHPF
Conv with mask3
Conv with mask4
BLPF
BHPF
motion bluring


MATLAB App
Input Image
Output Image
File Input name
image-002.bmp
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Mean Mask
N
5
ILPF
IHPF
Gauss Mask
Sigma
2
GLPF
GHPF
Conv with mask3
Conv with mask4
BLPF
BHPF
motion bluring


MATLAB App
Input Image
Output Image
File Input name
image-003.jpg
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Mean Mask
N
5
ILPF
IHPF
Gauss Mask
Sigma
2
GLPF
GHPF
Conv with mask3
Conv with mask4
BLPF
BHPF
motion bluring





iii. Analisa

- Mask 1 adalah mask yang menghasilkan efek blurring
- Mask 2 adalah mask yang menghasilkan efek edge detection 4 sisi
- Mask 3 adalah mask gaussian dan menghasilkan efek blur
- Mask 4 adalah masil yang menghasilkan efek edge detection namun diperlukan edge dari semua arah

b. Smoothing dan LowPass Filter

i. Kode Program

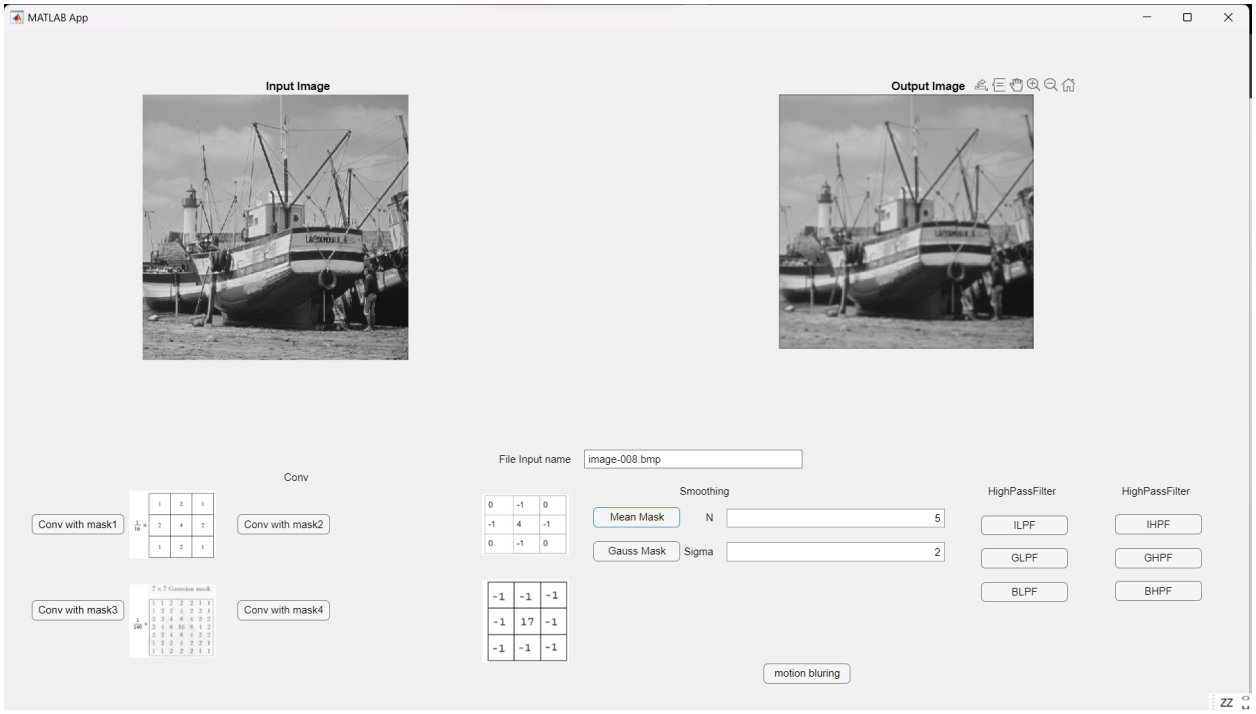
```
        % Button pushed function: MeanMaskButton
        function MeanMaskButtonPushed(app, event)
            filename = app.FileInputnameEditField.Value
            img_input = imread(filename);
            imshow(img_input, 'Parent', app.UIAxes);
            n = app.NEditField.Value
            sigma = app.SigmaEditField.Value
            img_result = uint8(image_mean_rgb(double(img_input), n));
            %img_result = uint8(image_gauss_rgb(double(img_input), n, sigma));

            imshow(img_result, 'Parent', app.UIAxes_2);

            function result = image_mean_rgb(image,n)
                mean_mask = ones(n) / (n * n);
                result = my_rgb_conv(image, mean_mask);
            end

            function result = image_gauss_rgb(image,n, sigma)
                % sigma = 2.0; % Change the sigma value as needed
                gaussian_mask = fspecial('gaussian', [n n], sigma);
                result = my_rgb_conv(image, gaussian_mask);
            end


           function result = my_rgb_conv(image, mask)
                [m, n, ~] = size(image);  % Get the dimensions and ignore the third dimension (color channels)
                [p, q] = size(mask);
                pad = floor((p - 1) / 2); % Padding
                result = zeros(m, n, 3);  % Initialize result for three color channels
                imagePadded = padarray(image, [pad, pad], 0, 'both');

                for c = 1:3
                    for i = 1:m
                        for j = 1:n
                            region = imagePadded(i:i+p-1, j:j+q-1, c);

                            % Melakukan konvolusi
                            result(i, j, c) = sum(sum(region .* mask));
                        end
                    end
                end
            end

        end
    end
```

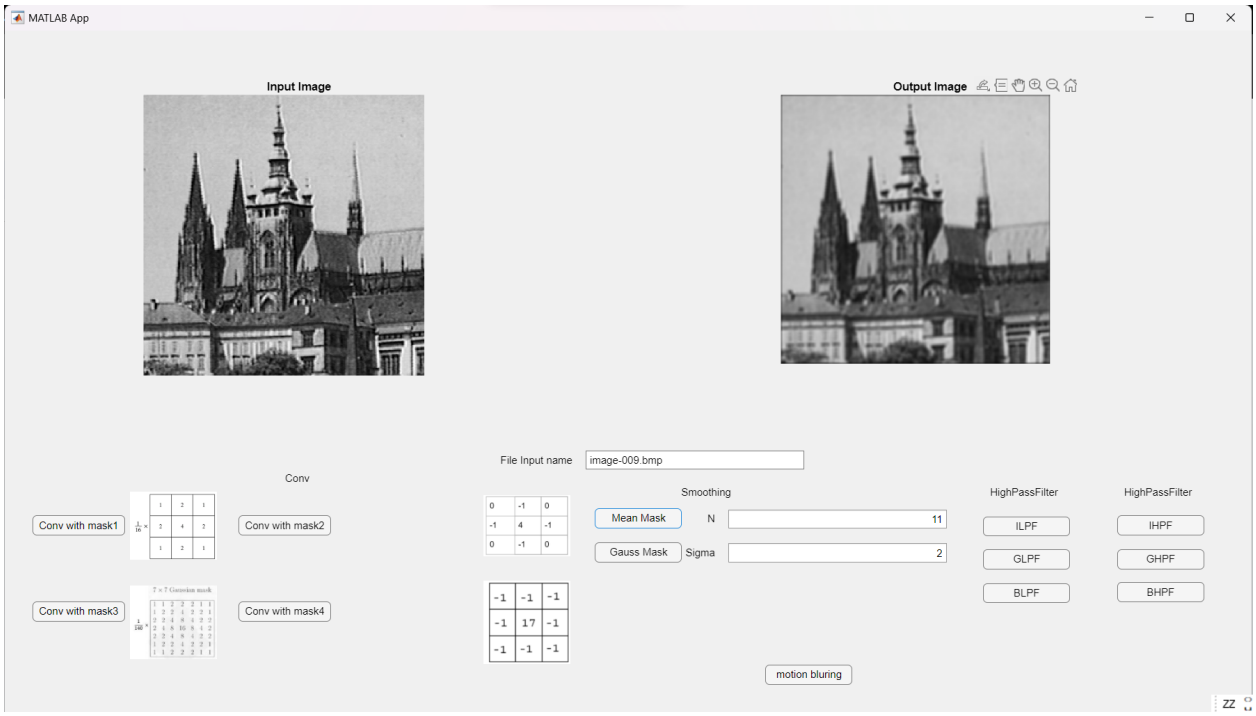
```
        % Button pushed function: GaussMaskButton
        function GaussMaskButtonPushed(app, event)
             filename = app.FileInputnameEditField.Value
            img_input = imread(filename);
            imshow(img_input, 'Parent', app.UIAxes);
            n = app.NEditField.Value
            sigma = app.SigmaEditField.Value
            %img_result = uint8(image_mean_rgb(double(img_input), n));
            img_result = uint8(image_gauss_rgb(double(img_input), n, sigma));

            imshow(img_result, 'Parent', app.UIAxes_2);

            function result = image_mean_rgb(image,n)
                mean_mask = ones(n) / (n * n);
                result = my_rgb_conv(image, mean_mask);
            end

            function result = image_gauss_rgb(image,n, sigma)
                % sigma = 2.0; % Change the sigma value as needed
                gaussian_mask = fspecial('gaussian', [n n], sigma);
                result = my_rgb_conv(image, gaussian_mask);
            end


           function result = my_rgb_conv(image, mask)
                [m, n, ~] = size(image);  % Get the dimensions and ignore the third dimension (color channels)
                [p, q] = size(mask);
                pad = floor((p - 1) / 2); % Padding
                result = zeros(m, n, 3);  % Initialize result for three color channels
                imagePadded = padarray(image, [pad, pad], 0, 'both');

                for c = 1:3
                    for i = 1:m
                        for j = 1:n
                            region = imagePadded(i:i+p-1, j:j+q-1, c);

                            % Melakukan konvolusi
                            result(i, j, c) = sum(sum(region .* mask));
                        end
                    end
                end
            end

        end
    end
```

Cat : apabila tombol gauss yang di tekan akan menggunakan fungsi image_gauss

ii. Hasil Eksekusi

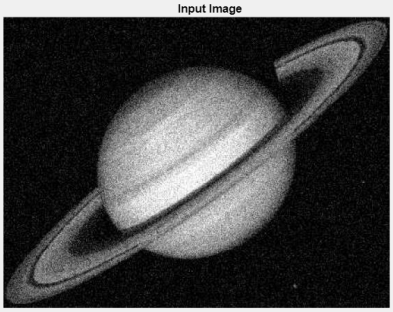
1. Mean Filter


MATLAB App
Input Image
Output Image
File Input name
image-008.bmp
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Mean Mask
N
5
Gauss Mask
Sigma
2
ILPF
GLPF
BLPF
IHPF
GHPF
BHPF
motion bluring

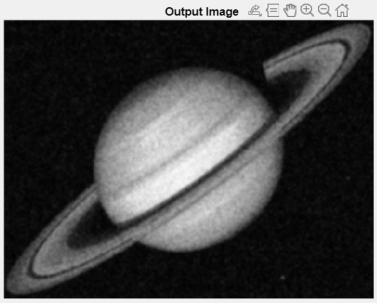

MATLAB App
Input Image
Output Image
File Input name
image-009.bmp
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Mean Mask
N
11
Gauss Mask
Sigma
2
ILPF
GLPF
BLPF
IHPF
GHPF
BHPF
motion bluring

MATLAB App

Input Image



Output Image



File Input name: image-010.jpg

Conv

Conv with mask1 | Conv with mask2

Conv with mask3 | Conv with mask4

Smoothing

Mean Mask | N: 5

Gauss Mask | Sigma: 2

HighPassFilter: ILPF | GLPF | BLPF

HighPassFilter: IHPF | GHPF | BHPF

motion bluring

MATLAB App

Input Image

Output Image

File Input name: image-011.jpg

Conv

Conv with mask1 | Conv with mask2

Conv with mask3 | Conv with mask4

Smoothing

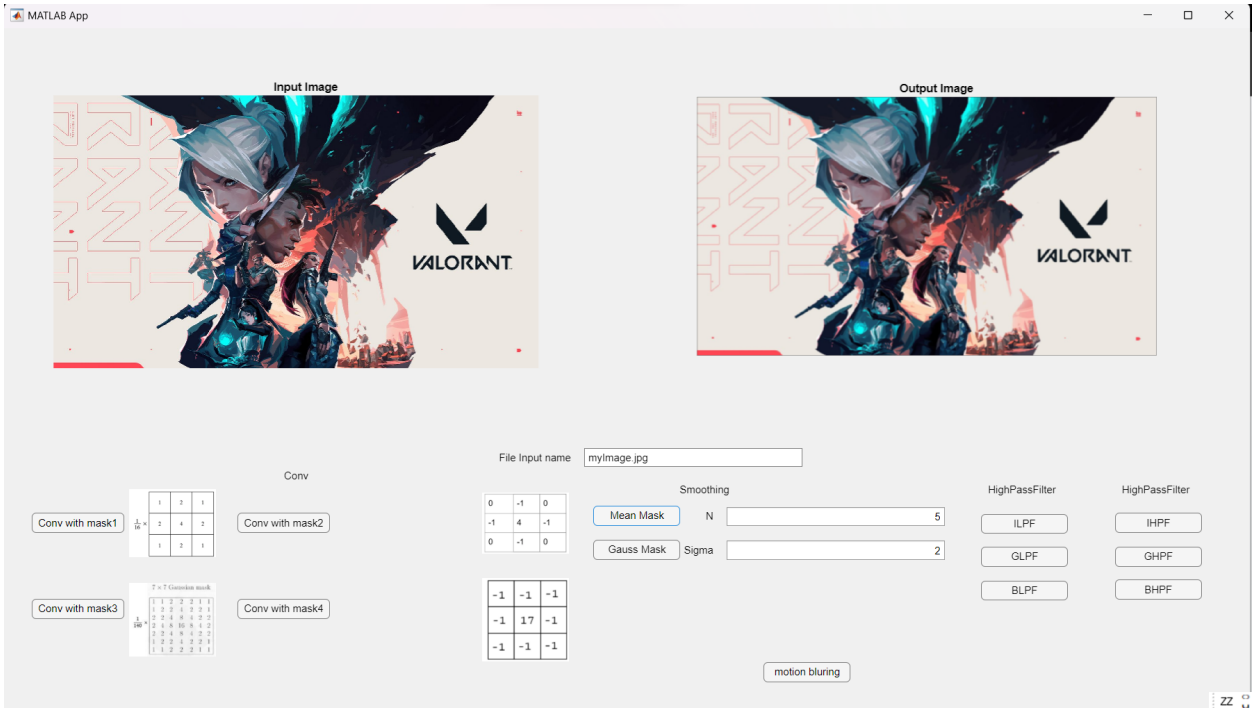
Mean Mask | N: 5

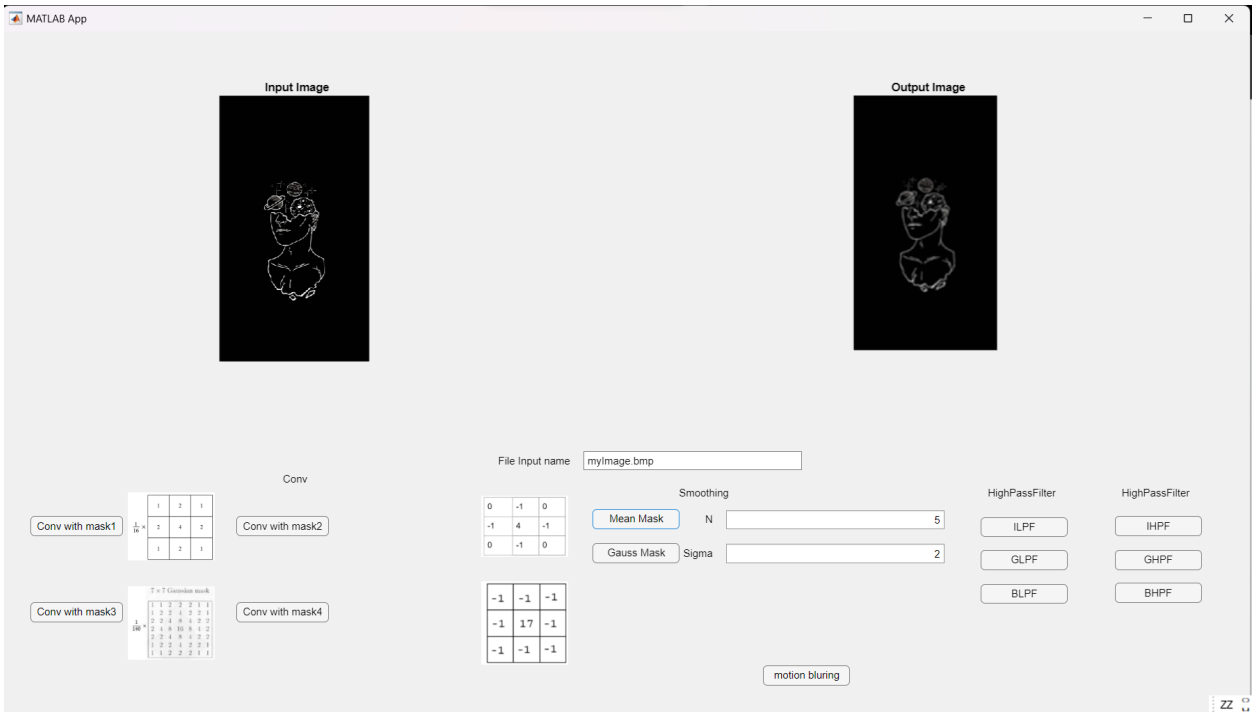
Gauss Mask | Sigma: 2

HighPassFilter: ILPF | GLPF | BLPF

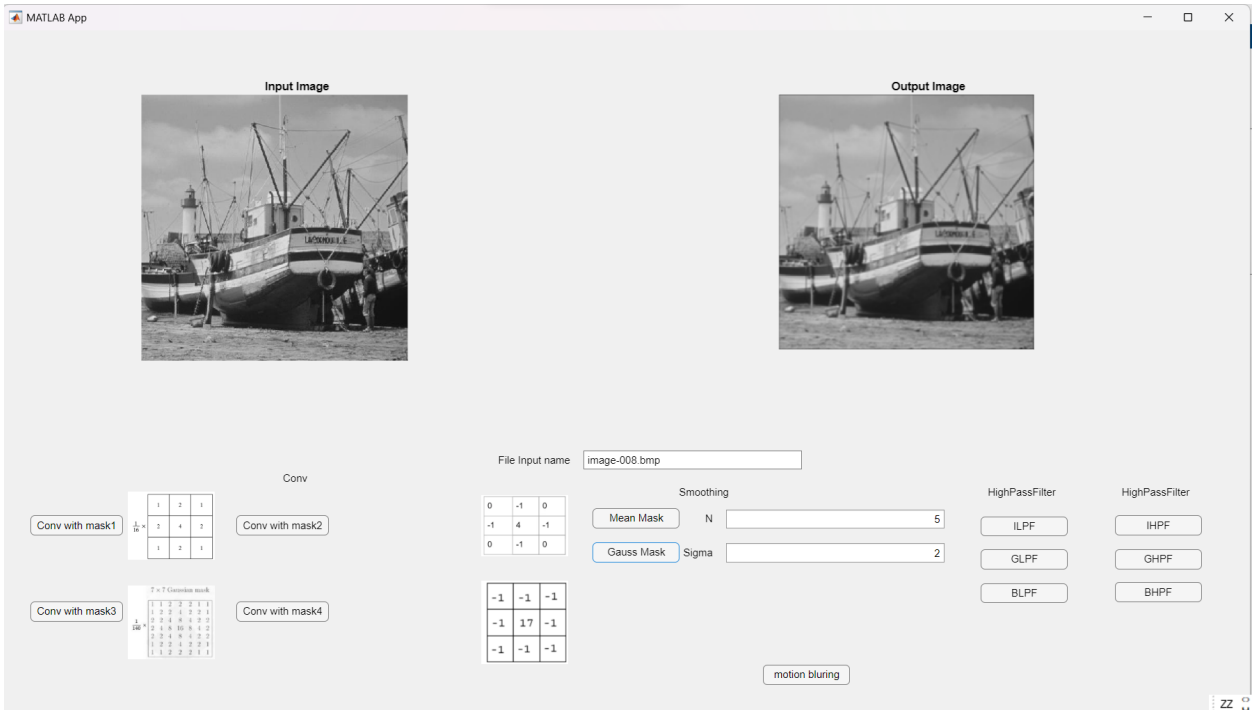
HighPassFilter: IHPF | GHPF | BHPF

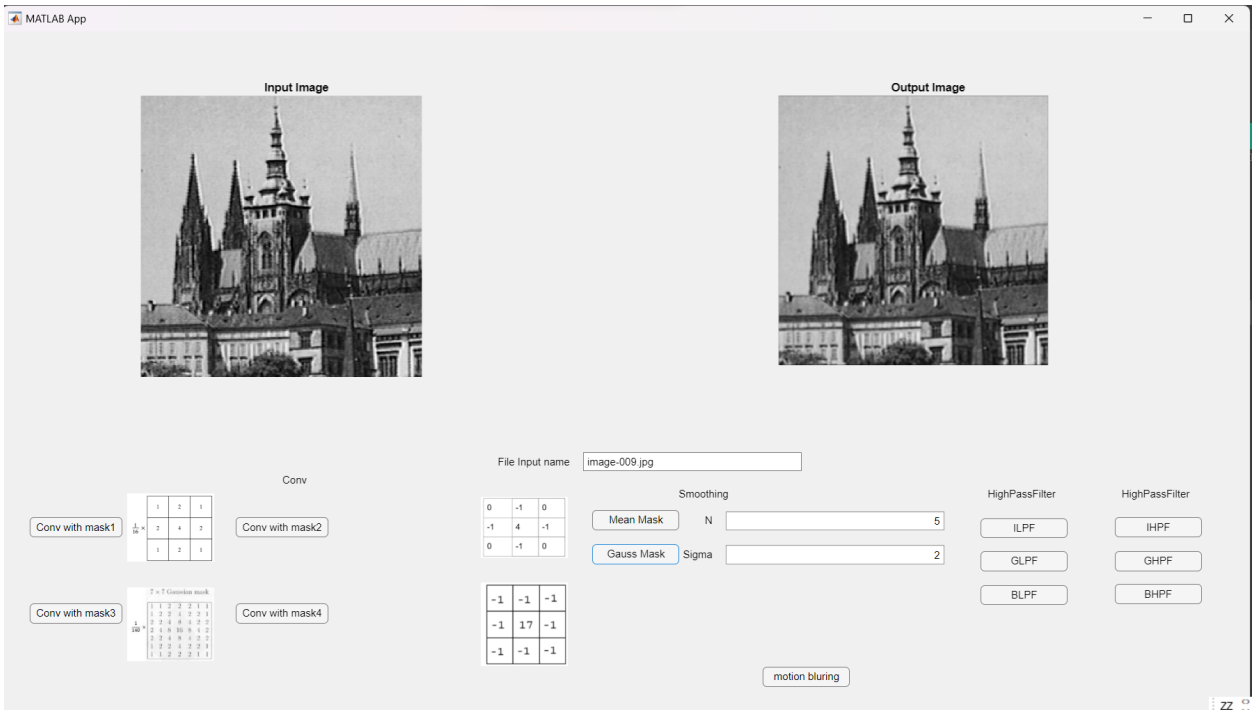
motion bluring

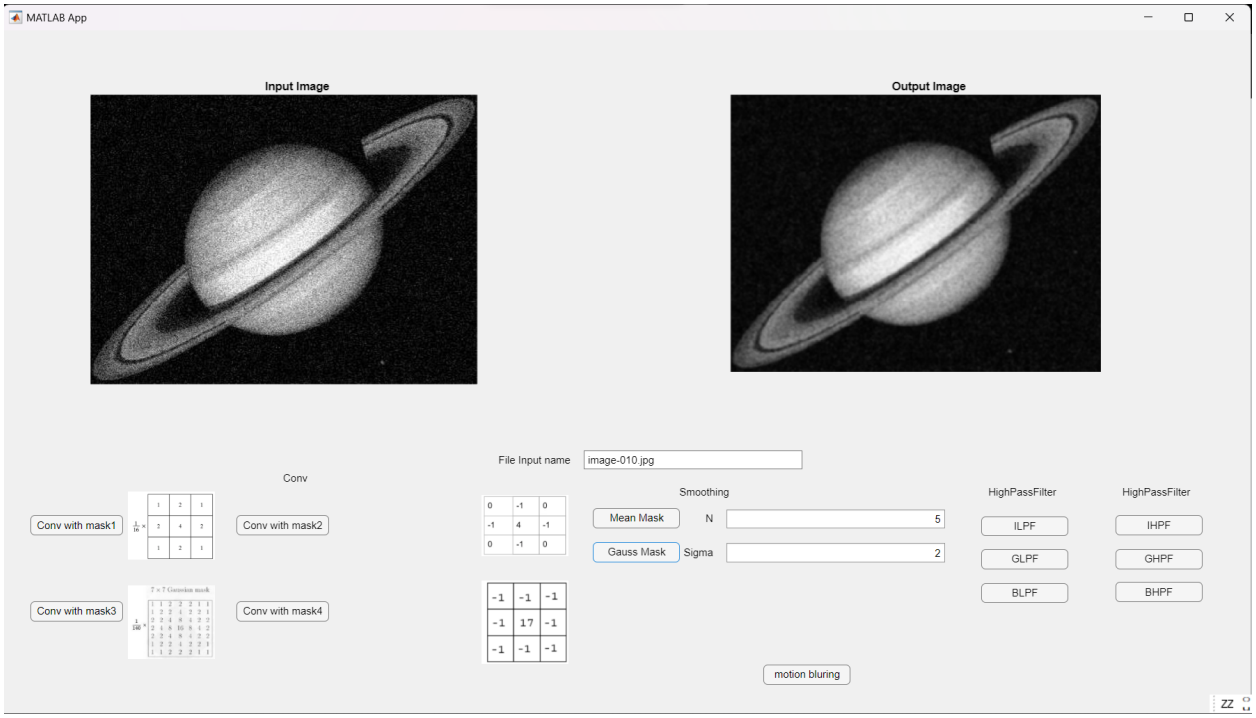


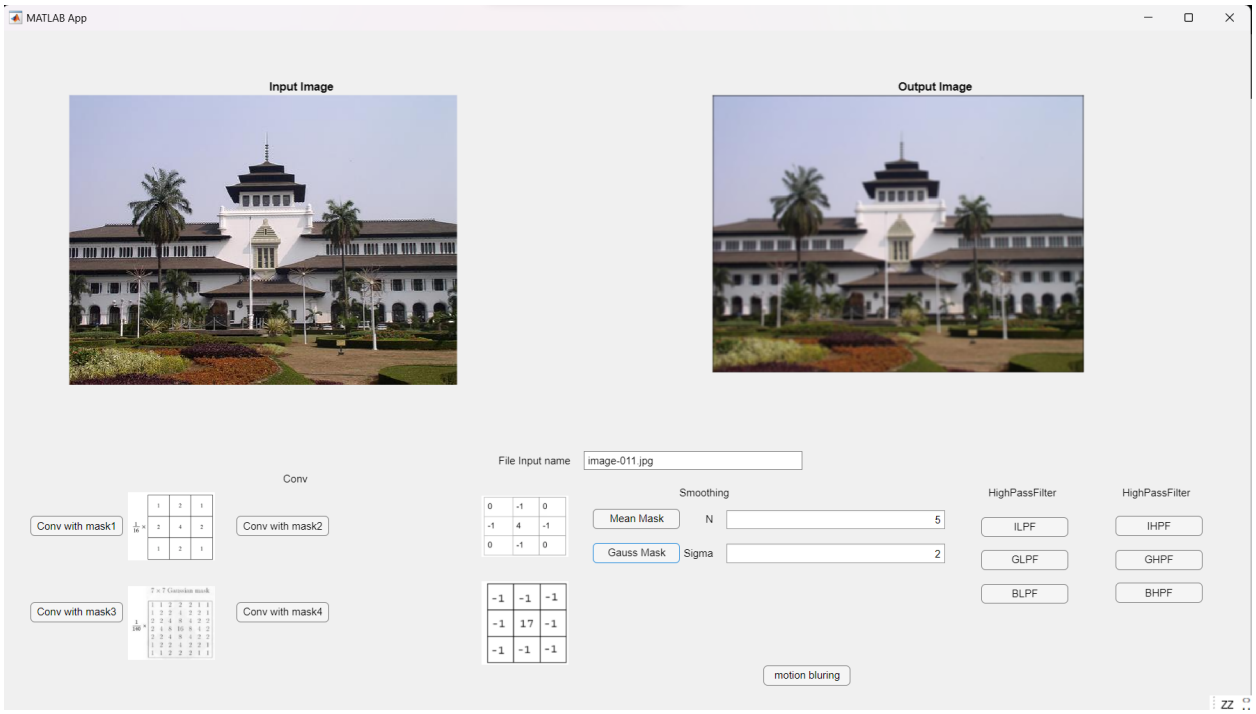


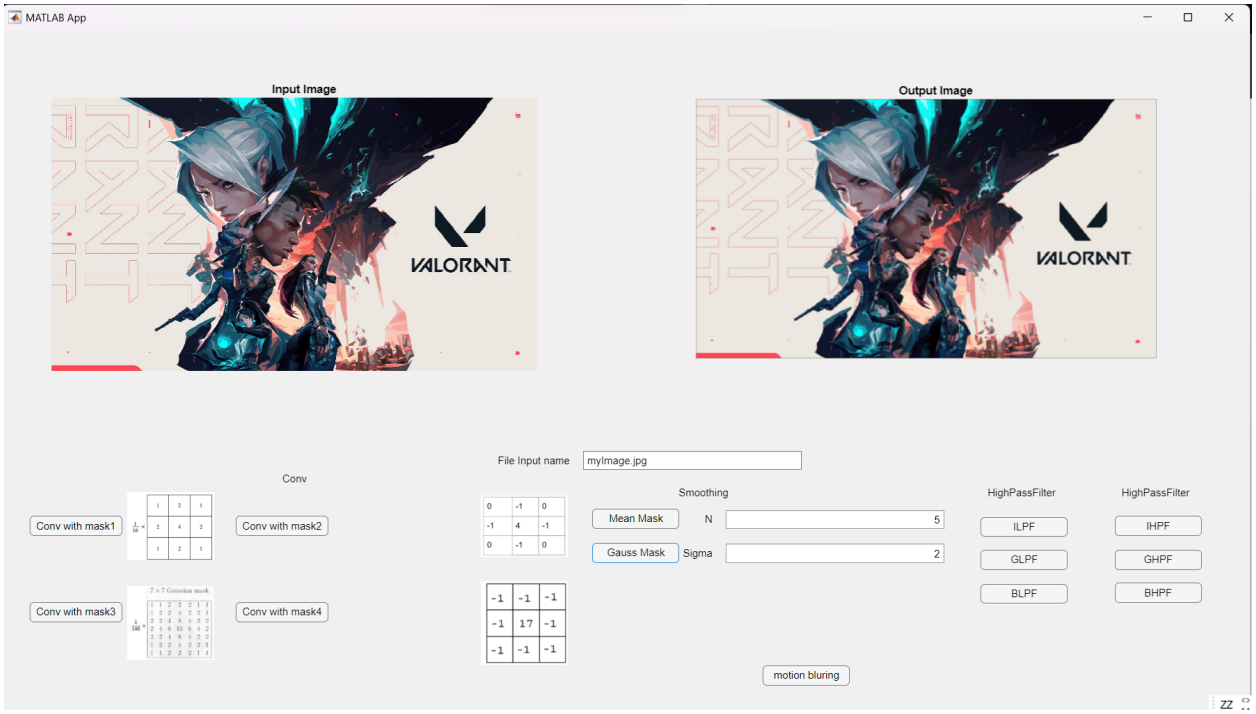
2. Gauss Filter

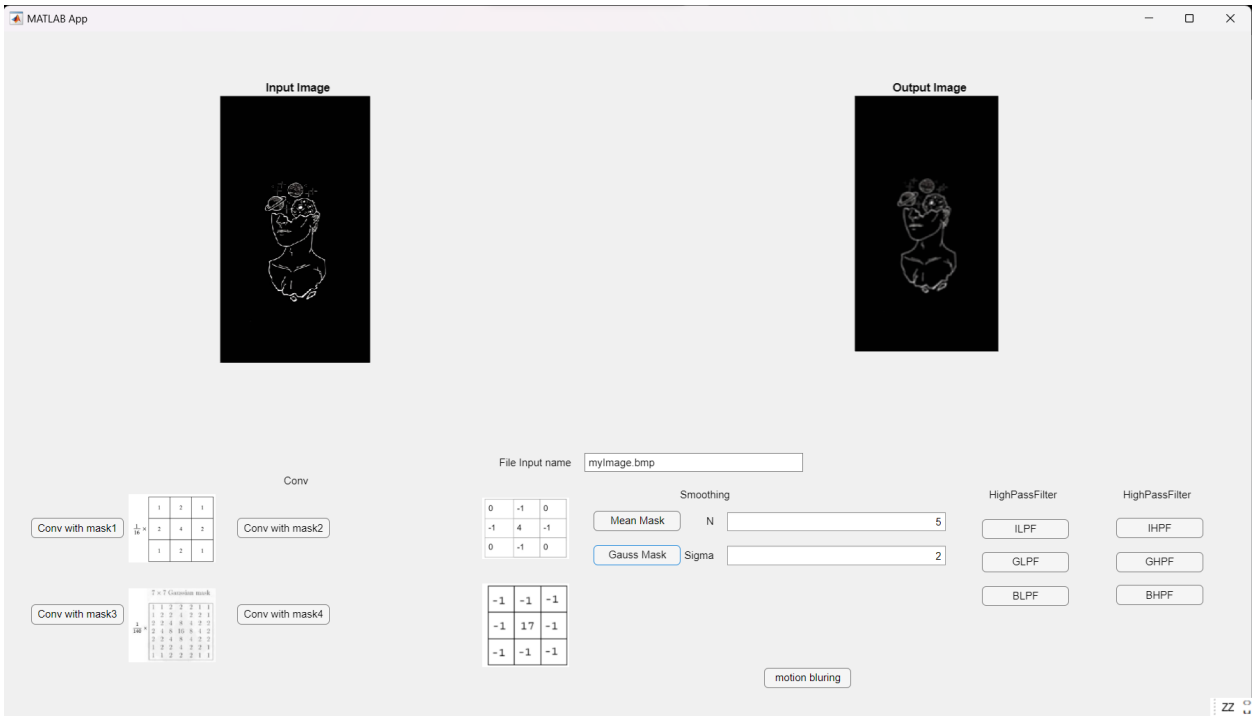

MATLAB App
Input Image
Output Image
File Input name
image-008.bmp
Conv
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Smoothing
Mean Mask
N
5
Gauss Mask
Sigma
2
HighPassFilter
ILPF
GLPF
BLPF
HighPassFilter
IHPF
GHPF
BHPF
motion bluring


MATLAB App
Input Image
Output Image
File Input name
image-009.jpg
Conv
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Smoothing
Mean Mask
N
5
Gauss Mask
Sigma
2
HighPassFilter
ILPF
GLPF
BLPF
HighPassFilter
IHPF
GHPF
BHPF
motion bluring

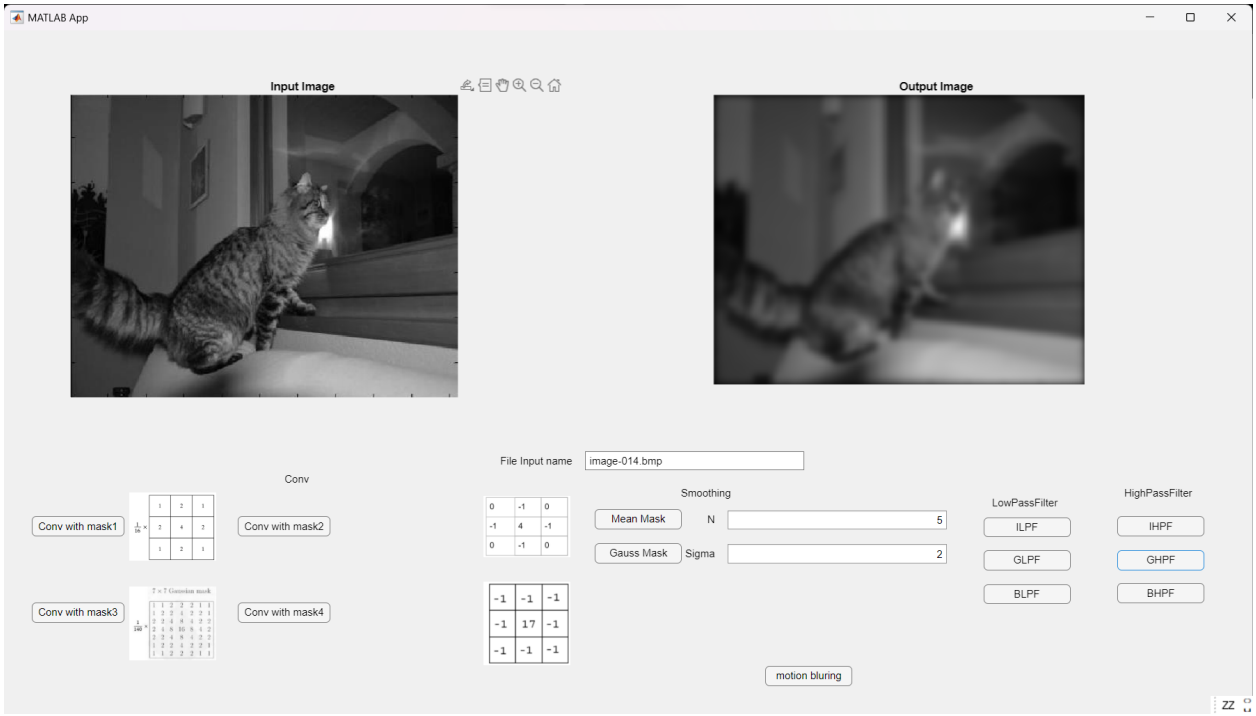

MATLAB App
Input Image
Output Image
File Input name
image-010.jpg
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Mean Mask
N
5
Gauss Mask
Sigma
2
ILPF
GLPF
BLPF
IHPF
GHPF
BHPF
motion bluring

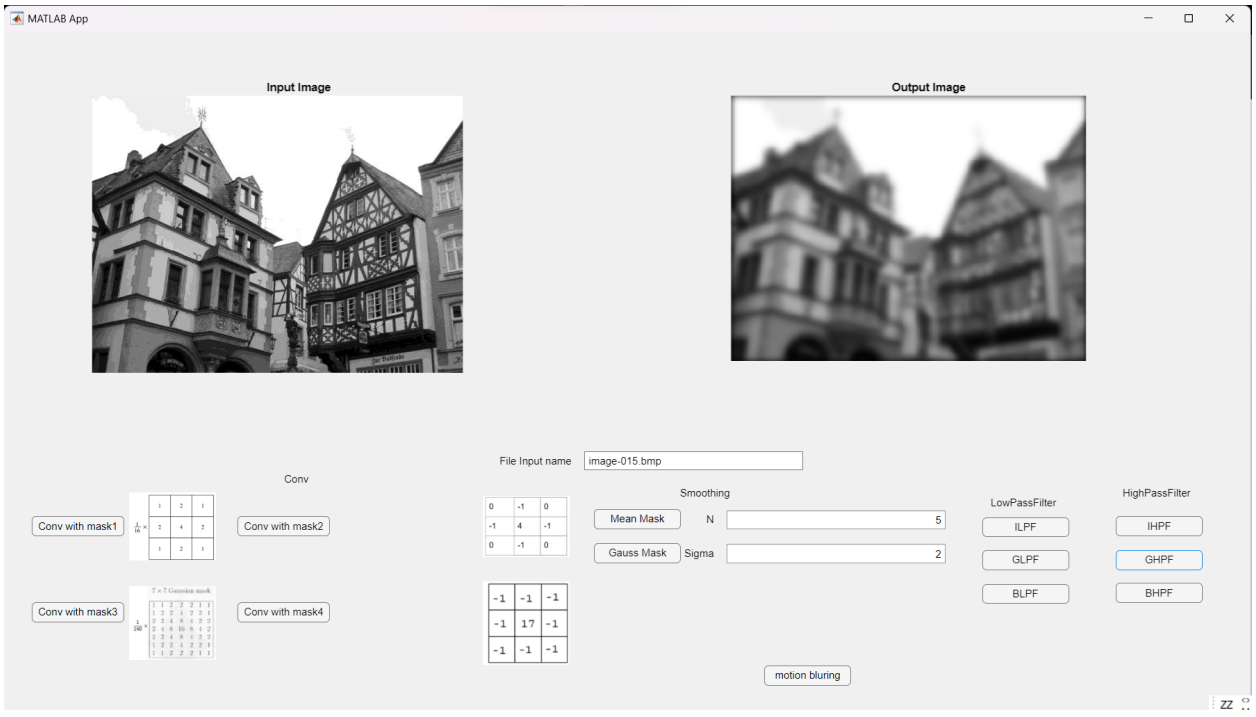

MATLAB App
Input Image
Output Image
File Input name
image-011.jpg
Conv
Smoothing
HighPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Mean Mask
N
5
Gauss Mask
Sigma
2
ILPF
GLPF
BLPF
IHPF
GHPF
BHPF
motion bluring

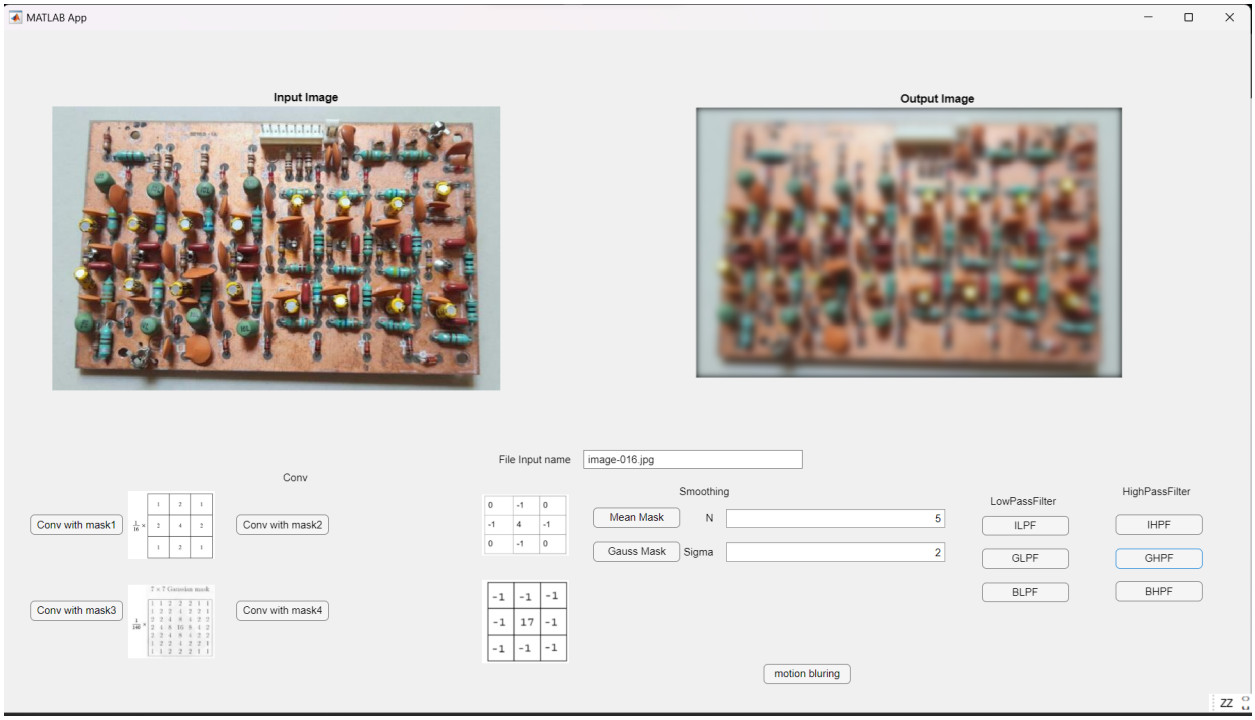


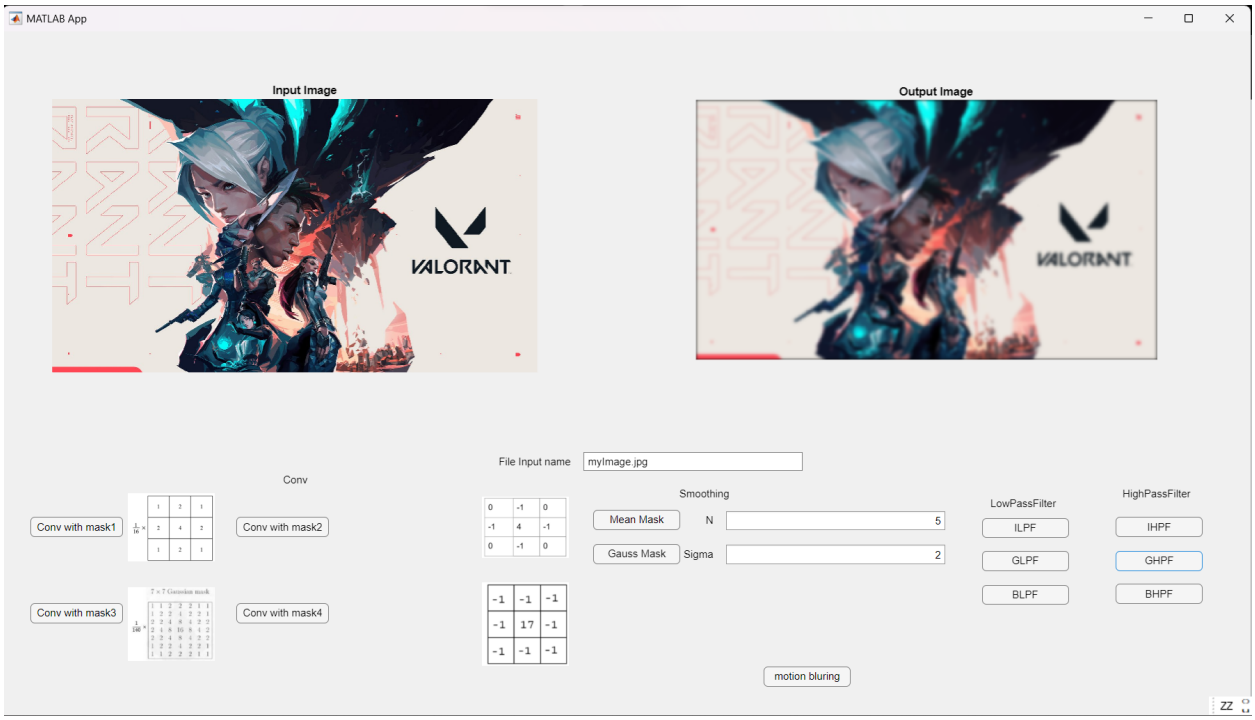


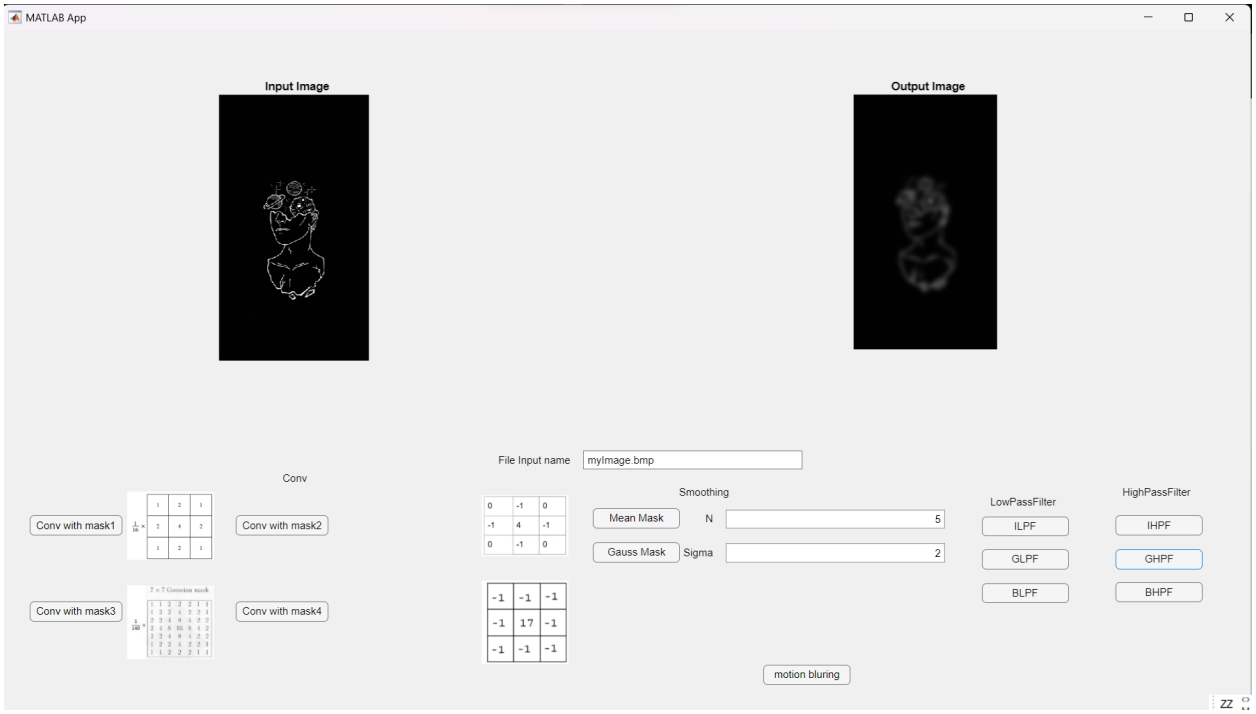
3. Low Pass Filter


MATLAB App
Input Image
Output Image
File Input name
image-014.bmp
Conv
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Smoothing
Mean Mask
N
5
Gauss Mask
Sigma
2
LowPassFilter
ILPF
GLPF
BLPF
HighPassFilter
IHPF
GHPF
BHPF
motion bluring


MATLAB App
Input Image
Output Image
File Input name
image-015.bmp
Conv
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Smoothing
Mean Mask
N
5
Gauss Mask
Sigma
2
LowPassFilter
ILPF
GLPF
BLPF
HighPassFilter
IHPF
GHPF
BHPF
motion bluring


MATLAB App
Input Image
Output Image
File Input name
image-016.jpg
Conv
Smoothing
LowPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Mean Mask
N
5
Gauss Mask
Sigma
2
ILPF
GLPF
BLPF
IHPF
GHPF
BHPF
motion bluring


MATLAB App
Input Image
Output Image
File Input name
myImage.jpg
Conv
Smoothing
LowPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Mean Mask
N
5
Gauss Mask
Sigma
2
ILPF
GLPF
BLPF
IHPF
GHPF
BHPF
motion bluring



iii. analisa

Kedua Mean mask, Gauss mask, dan low pass filter memiliki efek blurring namun pada kernel gauss pixel tengah kenel yang juga pixel asli pada posisi tersebut memiliki efek yang lebih besar daripada pixel di sekitarnya. Karena efek blurring ini juga kernel ini dapat menghilangkan beberapa jenis noise

c. Penapisan citra dalam ranah frekuensi (high-pass filter IHPF, GHPF, dan BHPF)

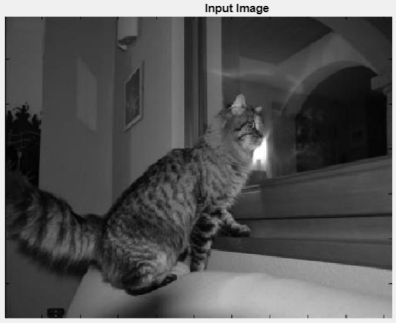
i. Kode Program

```
271  function IHPFButtonPushed(app, event)
272      % IHPF
273      filename = app.FileInputnameEditField.Value
274      img_input = imread(filename);
275      imshow(img_input, 'Parent', app.UIAxes);
276      ihpf_filter = fspecial('unsharp', 0.5);
277
278      img_result = imfilter(img_input, ihpf_filter);
279
280      imshow(img_result, 'Parent', app.UIAxes_2);
281
282  end
```

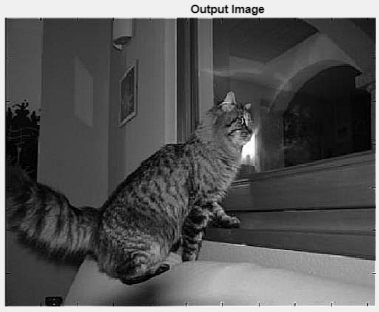
ii. Hasil Eksekusi

MATLAB App

Input Image



Output Image



File Input name: image-014.bmp

Conv

Conv with mask1 | Conv with mask2

Conv with mask3 | Conv with mask4

Smoothing

Mean Mask | N: 5

Gauss Mask | Sigma: 2

motion bluring

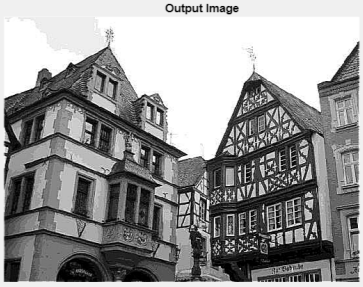
LowPassFilter: ILPF | GLPF | BLPF

HighPassFilter: IHPF | GHPF | BHPF

MATLAB App

Input Image

Output Image



File Input name: image-015.bmp

Conv

Conv with mask1 | Conv with mask2

Conv with mask3 | Conv with mask4

Smoothing

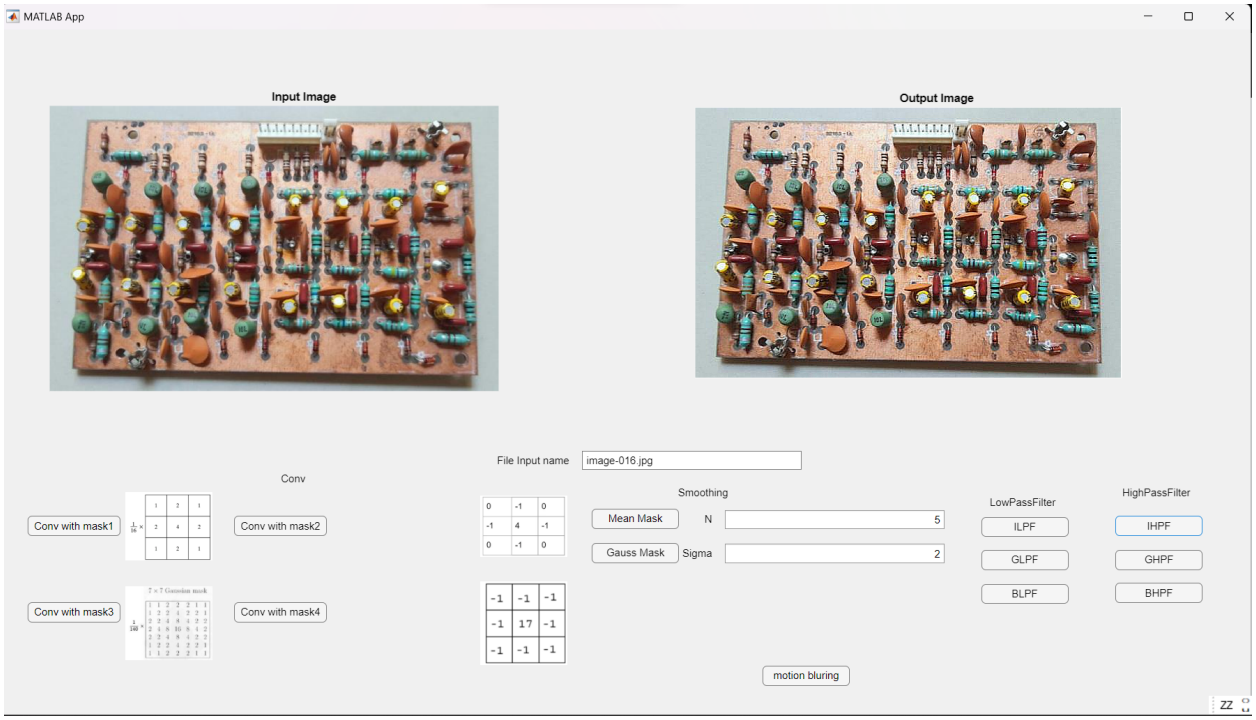
Mean Mask | N: 5

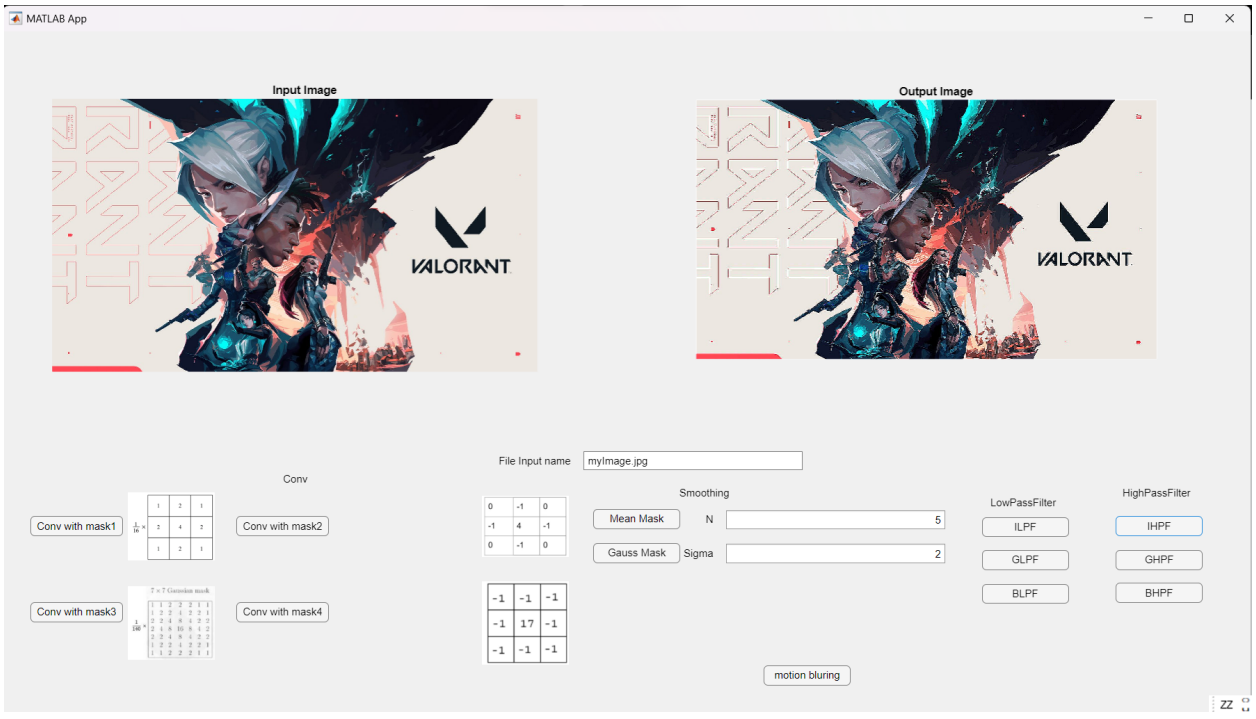
Gauss Mask | Sigma: 2

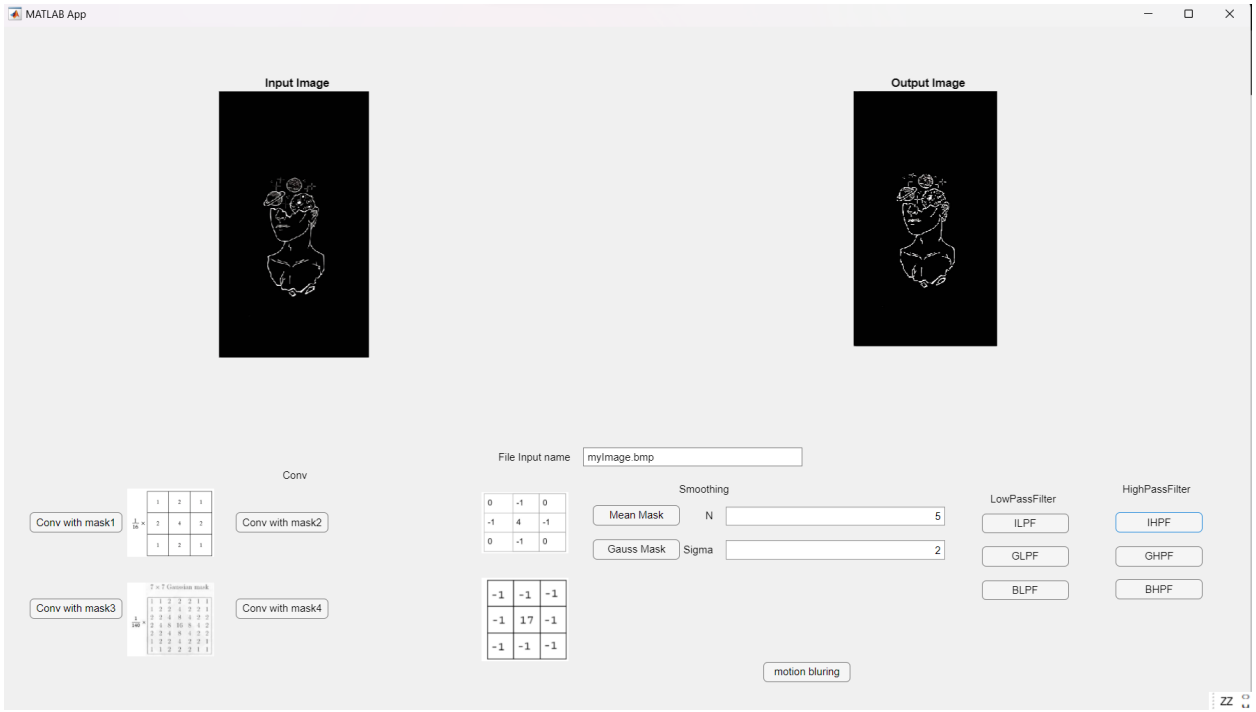
motion bluring

LowPassFilter: ILPF | GLPF | BLPF

HighPassFilter: IHPF | GHPF | BHPF


MATLAB App
Input Image
Output Image
File Input name
image-016.jpg
Conv
Smoothing
LowPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Mean Mask
N
5
Gauss Mask
Sigma
2
ILPF
IHPF
GLPF
GHPF
BLPF
BHPF
motion bluring


MATLAB App
Input Image
Output Image
File Input name
myImage.jpg
Conv
Smoothing
LowPassFilter
HighPassFilter
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
Mean Mask
N
5
Gauss Mask
Sigma
2
ILPF
IHPF
GLPF
GHPF
BLPF
BHPF
motion bluring



1. Analisa

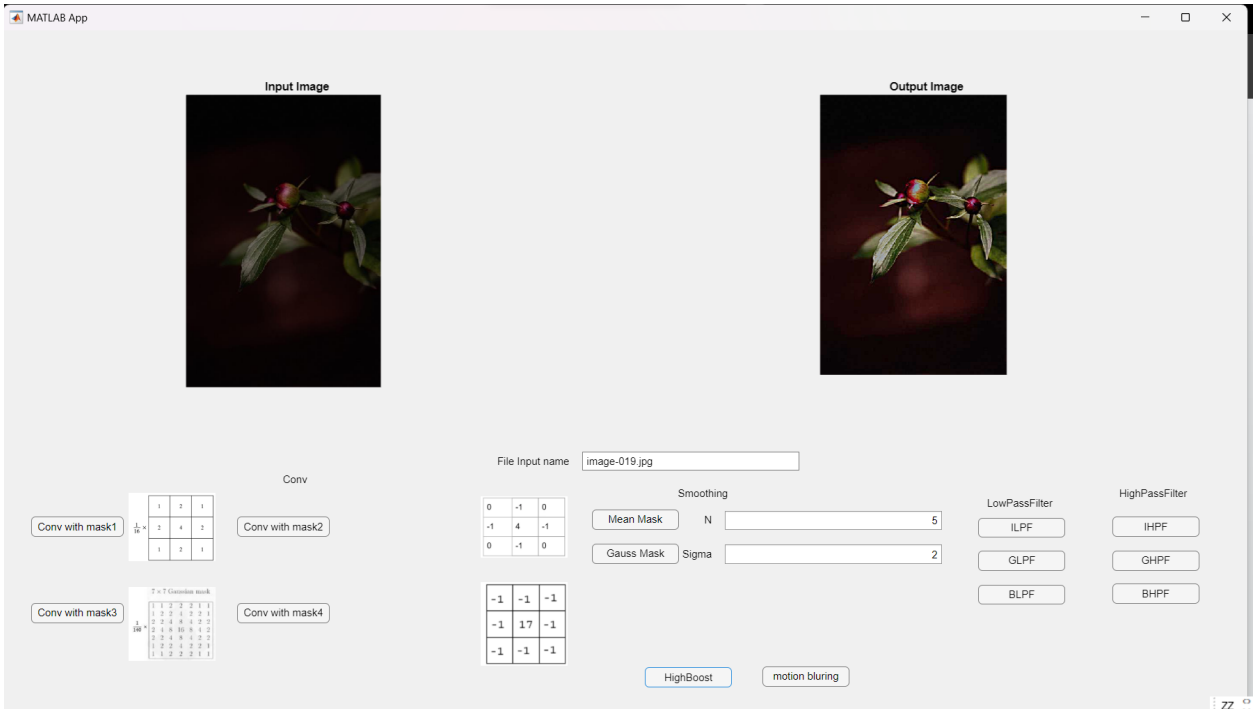
   High Pass Filter (IHPF, GHPF, BHPF) memiliki efek edge/image sharpening. Dengan BHPF dengan threshold yang lebih gradual memiliki hasil yang paling bagus

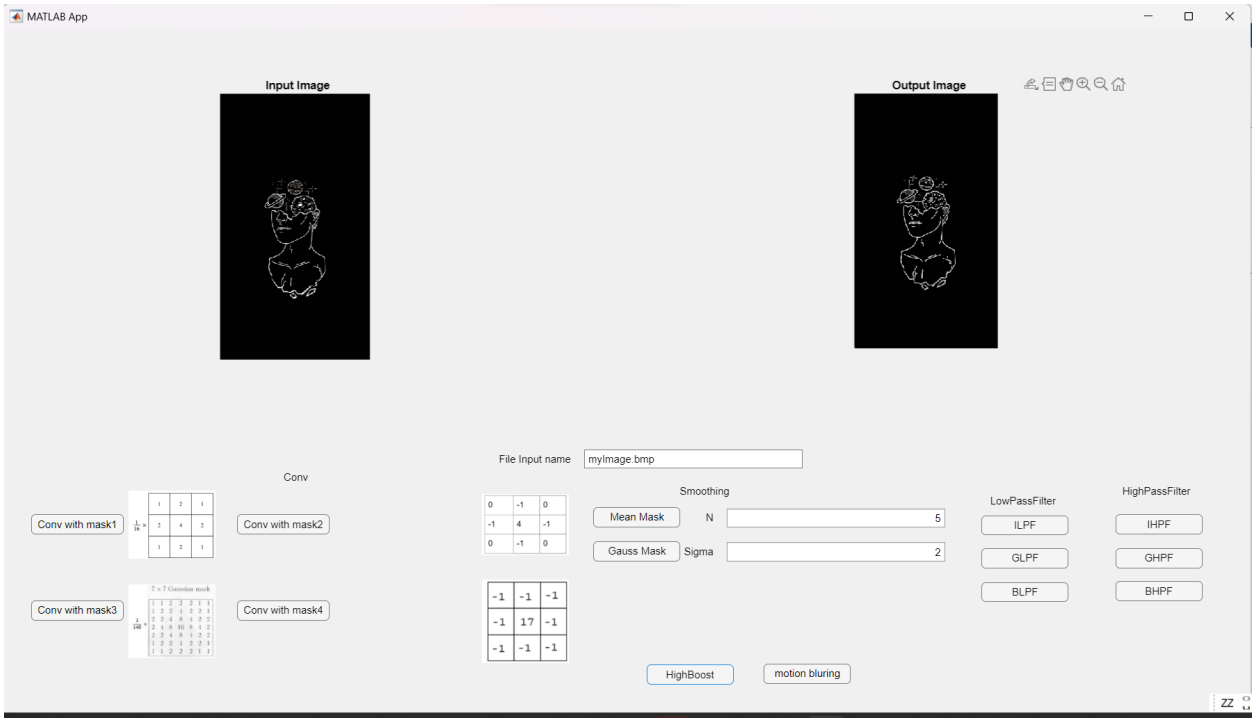
d. High Frequency Boost Filtering (Penapisan citra dalam ranah frekuensi untuk menghasilkan citra yang lebih terang)

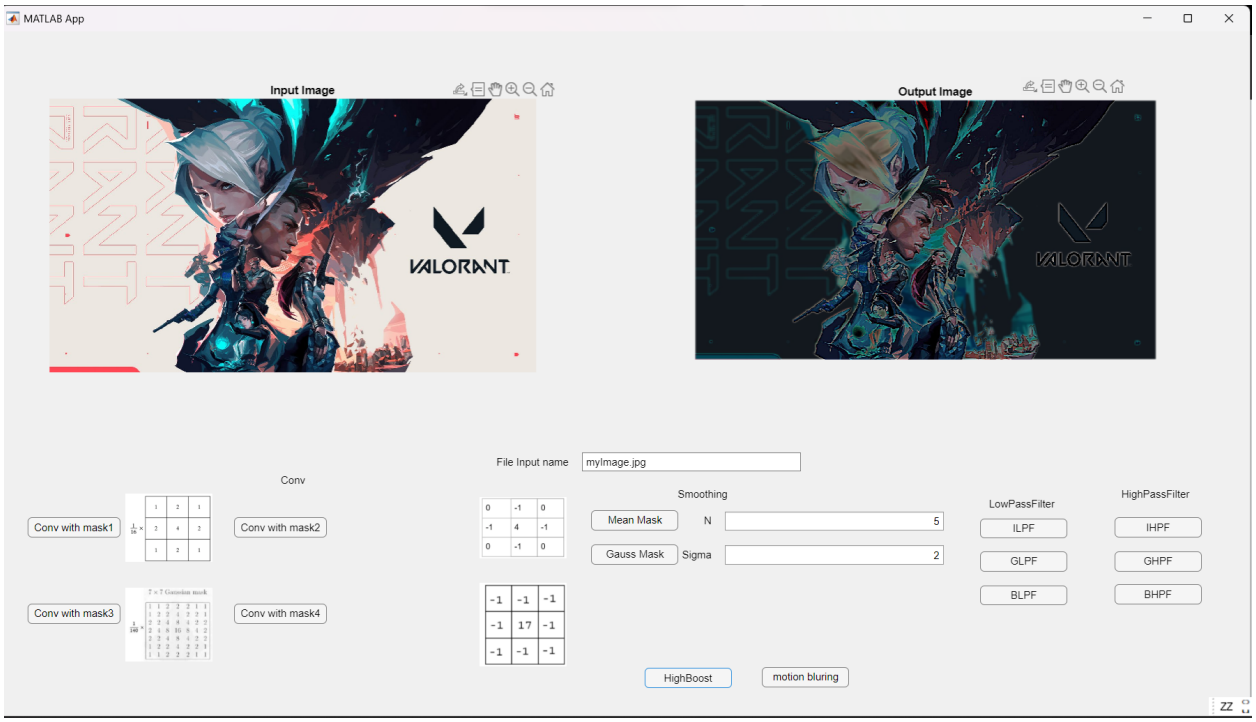
   i. Kode Program

```
333         % Button pushed function: HighBoostButton
334         function HighBoostButtonPushed(app, event)
335
336             % BHPF
337             filename = app.FileInputnameEditField.Value
338             img_input = imread(filename);
339             imshow(img_input, 'Parent', app.UIAxes);
340
341             h_size = 10
342             Sigma = 5
343             A = 2
344             GLPF = fspecial('gaussian',h_size,Sigma);
345             GLPF_Image = imfilter(img_input,GLPF);
346
347             High_pass_filter = img_input - GLPF_Image;
348
349             Unsharpened_Image = (1*img_input) + High_pass_filter;
350
351             HFBF_Image = (A-1)*img_input + img_input - GLPF_Image;
352
353             imshow(HFBF_Image, 'Parent', app.UIAxes_2);
354
355         end
356
357         % Button pushed function: motionbluringButton
```

ii. Hasil Eksekusi







iii. Analisa

Yang dilakukan pada gambar pada prinsipnya adalah High Frequency Boost Filtering(HFBF) yang memperkuat pixel - pixel dengan frequensi tinggi tanpa mengubah pixel - pixel dengan frekuensi rendah

e. Penghilangan Derau Salt and Pepper

i. Kode Program

```
function spek5()
    % Baca citra grayscale
    gray_image = imread('image-021.bmp');
    gray_myImage = imread('myImage.bmp');


    % Baca citra berwarna
    color_image = imread('image-022.jpg');
    color_myImage = imread('myImage.jpg');

    kernelSize = 3
    color_image_saltnpepper = imnoise( color_image ,'salt & pepper')

    min_denoised_image = min_filter(color_image_saltnpepper,kernelSize);
    max_denoised_image = max_filter(color_image_saltnpepper,kernelSize);
    median_denoised_image = median_filter(color_image_saltnpepper,kernelSize);
    arithmetic_mean_denoised_image = arithmetic_mean_filter(color_image_saltnpepper,kernelSize);
    geometric_denoised_image = geometric_filter(color_image_saltnpepper,kernelSize,45);
    harmonic_mean_denoised_image = harmonic_mean_filter(color_image_saltnpepper,kernelSize);
    % contraharmonic_mean_denoised_image = contraharmonic_mean_filter(color_image_saltnpepper,kernelSize, 1.5);
    midpoint_denoised_image = midpoint_filter(color_image_saltnpepper,kernelSize);
    alpha_trimmed_mean_denoised_image = alpha_trimmed_mean_filter(color_image_saltnpepper,kernelSize,2);

    figure;
    subplot(5, 2, 1);
    imshow(gray_image);
    title('Original Asli');

    subplot(5, 2, 2);
    imshow(color_image_saltnpepper);
    title('Citra saltnpepper');

    subplot(5, 2, 3);
    imshow(uint8(min_denoised_image));
    title('Citra min_denoised_image');

    subplot(5, 2, 4);
    imshow(uint8(max_denoised_image));
    title('Citra max_denoised_image');

    subplot(5, 2, 5);
    imshow(uint8(median_denoised_image));
    title('Citra median_denoised_image');
```

```
function outputImage = min_filter(inputImage, kernelSize)
    % dimensi gambar
    [rows, cols, channels] = size(inputImage);

    % init output
    outputImage = zeros(rows, cols, channels);

    % radius kernel
    radius = (kernelSize - 1) / 2;

    for c = 1:channels
        for i = 1:rows
            for j = 1:cols
                neighborhood = inputImage(max(1, i - radius):min(rows, i + radius), ...
                                          max(1, j - radius):min(cols, j + radius), c);

                outputImage(i, j, c) = min(neighborhood(:));
            end
        end
    end
end
```

```
function outputImage = max_filter(inputImage, kernelSize)
    % dimensi gambar
    [rows, cols, channels] = size(inputImage);

    % init output
    outputImage = zeros(rows, cols, channels);

    % radius kernel
    radius = (kernelSize - 1) / 2;

    for c = 1:channels
        for i = 1:rows
            for j = 1:cols
                neighborhood = inputImage(max(1, i - radius):min(rows, i + radius), ...
                                          max(1, j - radius):min(cols, j + radius),c);

                outputImage(i, j,c) = max(neighborhood(:));
            end
        end
    end
end
```

```
function outputImage = median_filter(inputImage, kernelSize)

    % dimensi gambar
    [rows, cols, channels] = size(inputImage);

    % init output
    outputImage = zeros(rows, cols, channels);

    % radius kernel
    radius = (kernelSize - 1) / 2;

    for c = 1:channels
        for i = 1:rows
            for j = 1:cols
                % Get the neighborhood of the current pixel
                neighborhood = inputImage(max(1, i - radius):min(rows, i + radius), ...
                                          max(1, j - radius):min(cols, j + radius),c);

                % Apply the median filter operation
                outputImage(i, j,c) = median(neighborhood(:));
            end
        end
    end
end
```

```
function outputImage = arithmetic_mean_filter(inputImage, kernelSize)
    % dimensi gambar
    [rows, cols, channels] = size(inputImage);

    % init output
    outputImage = zeros(rows, cols, channels);

    % radius kernel
    radius = (kernelSize - 1) / 2;

    for c = 1:channels
        for i = 1:rows
            for j = 1:cols
                neighborhood = inputImage(max(1, i - radius):min(rows, i + radius), ...
                                          max(1, j - radius):min(cols, j + radius),c);

                outputImage(i, j,c) = mean(neighborhood(:));
            end
        end
    end
end
```

```
function outputImage = geometric_filter(inputImage, kernelSize, angle_degrees)


    % dimensi gambar
    [rows, cols, channels] = size(inputImage);

    % init output
    outputImage = zeros(rows, cols, channels);

    % radius kernel
    radius = (kernelSize - 1) / 2;

    % Convert the angle from degrees to radians      You, 39 minutes ago • spek 5 6
    angle_radians = deg2rad(angle_degrees);

    for c = 1:channels
        for i = 1:rows
            for j = 1:cols

                neighborhood = inputImage(max(1, i - radius):min(rows, i + radius), ...
                                          max(1, j - radius):min(cols, j + radius),c);


                rotated_neighborhood = imrotate(neighborhood, angle_degrees, 'bilinear', 'crop');

                center = floor(size(rotated_neighborhood) / 2) + 1;

                outputImage(i, j,c) = rotated_neighborhood(center(1), center(2));
            end
        end
    end
end
```

```
end
function outputImage = harmonic_mean_filter(inputImage, kernelSize)



    % dimensi gambar
    [rows, cols, channels] = size(inputImage);

    % init output
    outputImage = zeros(rows, cols, channels);

    % radius kernel
    radius = (kernelSize - 1) / 2;

    for c = 1:channels
        for i = 1:rows
            for j = 1:cols
                % Get the neighborhood of the current pixel
                neighborhood = inputImage(max(1, i - radius):min(rows, i + radius), ...
                                          max(1, j - radius):min(cols, j + radius),c);

                reciprocal_neighborhood = 1 ./ double(neighborhood);
                harmonic_mean = kernelSize^2 / sum(reciprocal_neighborhood(:));

                outputImage(i, j,c) = harmonic_mean;
            end
        end
    end
end
function outputImage = contraharmonic_mean_filter(inputImage, kernelSize, Q)
```

```m
function outputImage = contraharmonic_mean_filter(inputImage, kernelSize, q)

        You, 39 minutes ago • spek 5 6
    % dimensi gambar
    [rows, cols, channels] = size(inputImage);

    % init output
    outputImage = zeros(rows, cols, channels);


    % radius kernel
    radius = (kernelSize - 1) / 2;
    for c = 1:channels
        for i = 1:rows
            for j = 1:cols
                neighborhood = inputImage(max(1, i - radius):min(rows, i + radius), ...
                                          max(1, j - radius):min(cols, j + radius),c);

                numerator = sum(neighborhood(:) .^ (q + 1));
                denominator = sum(neighborhood(:) .^ q);

                if denominator == 0
                    outputImage(i, j,c) = 0;
                else
                    outputImage(i, j,c) = numerator / denominator;
                end
            end
        end
    end
end
```

```m
function outputImage = midpoint_filter(inputImage, kernelSize)


    % dimensi gambar
    [rows, cols, channels] = size(inputImage);

    % init output
    outputImage = zeros(rows, cols, channels);


    % radius kernel
    radius = (kernelSize - 1) / 2;
    for c = 1:channels
        for i = 1:rows
            for j = 1:cols
                neighborhood = inputImage(max(1, i - radius):min(rows, i + radius), ...
                                          max(1, j - radius):min(cols, j + radius),c);

                outputImage(i, j,c) = median(neighborhood(:));
            end
        end
    end
end
```

```
function outputImage = alpha_trimmed_mean_filter(inputImage, kernelSize, d)


    % dimensi gambar
    [rows, cols, channels] = size(inputImage);

    % init output
    outputImage = zeros(rows, cols, channels);


    % radius kernel
    radius = (kernelSize - 1) / 2;
    for c = 1:channels
        for i = 1:rows
            for j = 1:cols
                neighborhood = inputImage(max(1, i - radius):min(rows, i + radius), ...
                                          max(1, j - radius):min(cols, j + radius),c);

                sorted_neighborhood = sort(neighborhood(:));

                trimmed_neighborhood = sorted_neighborhood((d/2 + 1):(end - d/2));

                outputImage(i, j,c) = mean(trimmed_neighborhood);
            end
        end
    end
end
```

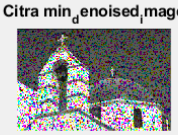
ii. Hasil Eksekusi

low Help

Original Asli

Citra saltnpepper

Citra min$_d$enoised$_I$mage



Citra max$_d$enoised$_I$mage

Citra median$_d$enoised$_I$mage

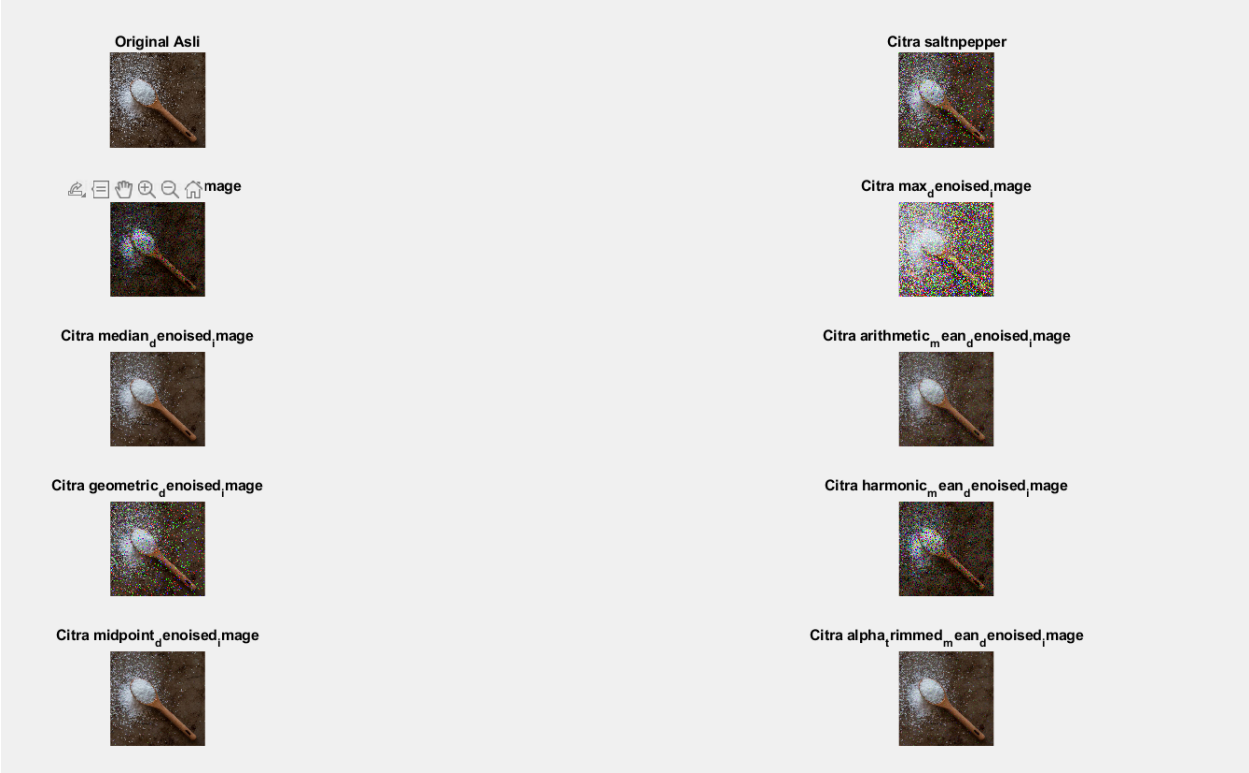
Citra arithmetic$_m$ean$_d$enoised$_I$mage

Citra geometric$_d$enoised$_I$mage

Citra harmonic$_m$ean$_d$enoised$_I$mage

Citra midpoint$_d$enoised$_I$mage

Citra alpha$_t$rimmed$_m$ean$_d$enoised$_I$mage



iii. Analisa

- Median filter, midpoint, dan alpha rimmed mean berhasil men filter derau salt and paper dengan cukup baik
- Min filter gagal men filter pixel dengan value tinggi
- Max filter gagal men filter pixel dengan value rendah
- Arithmetic Median filter berhasil men filter derau salt and pepper dengan cukup baik
- Geometric filter, dan Harmonic mean gagal memfilter derau salt and pepper

f. Penghilangan Derau Periodik

i. Kode Program

```
% matlab nya:
function spek6()

    grayImage = imread('image-029.bmp');
    [rows columns channel] = size(grayImage);
    if channel > 1
        grayImage = rgb2gray(grayImage);
    end
    subplot(2, 3, 1);
    imshow(grayImage, [0 255]);

    frequencyImage = fftshift(fft2(grayImage));
    amplitudeImage = log(abs(frequencyImage));
    minValue = min(min(amplitudeImage))
    maxValue = max(max(amplitudeImage))
    subplot(2, 3, 4);
    imshow(amplitudeImage, []);

    amplitudeThreshold = 10.97;
    brightSpikes = amplitudeImage > amplitudeThreshold;
    subplot(2, 3, 5);
    imshow(brightSpikes);

    brightSpikes(115:130, :) = 0;
    imshow(brightSpikes);
    frequencyImage(brightSpikes) = 0;
    amplitudeImage2 = log(abs(frequencyImage));
    minValue = min(min(amplitudeImage2))
    maxValue = max(max(amplitudeImage2))
    subplot(2, 3, 5);
    imshow(amplitudeImage2, [minValue maxValue]);
    axis on;

    filteredImage = ifft2(fftshift(frequencyImage));
    amplitudeImage3 = abs(filteredImage);
    minValue = min(min(amplitudeImage3))
    maxValue = max(max(amplitudeImage3))
    subplot(2, 3, 6);
    imshow(amplitudeImage3, [minValue maxValue]);
    title('Filtered Image');


end
```

ii. Hasil Eksekusi

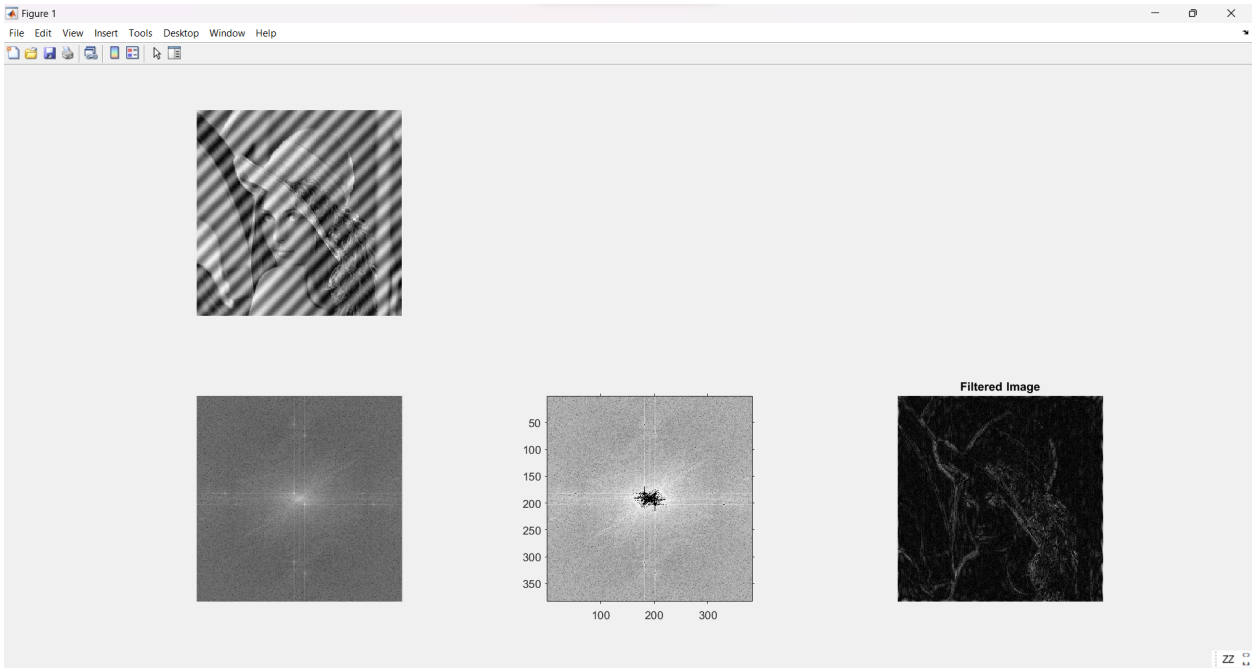
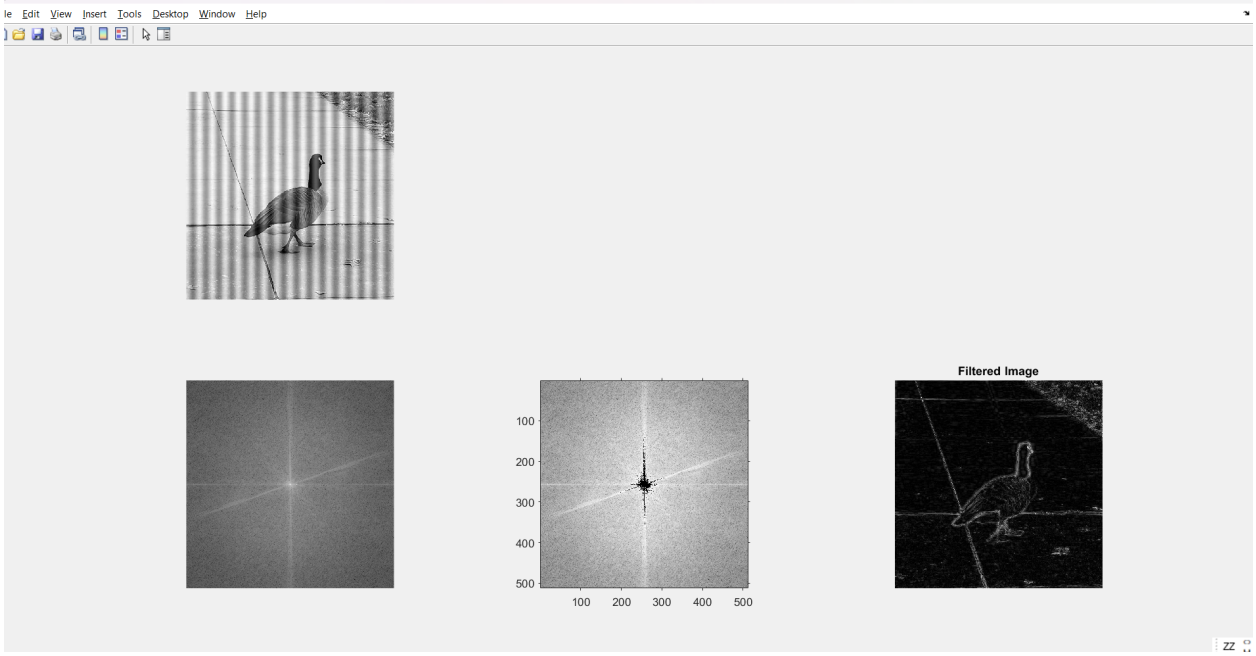


Figure 1
File Edit View Insert Tools Desktop Window Help
Filtered Image
50
100
150
200
250
300
350
100
200
300


le Edit View Insert Tools Desktop Window Help
Filtered Image
100
200
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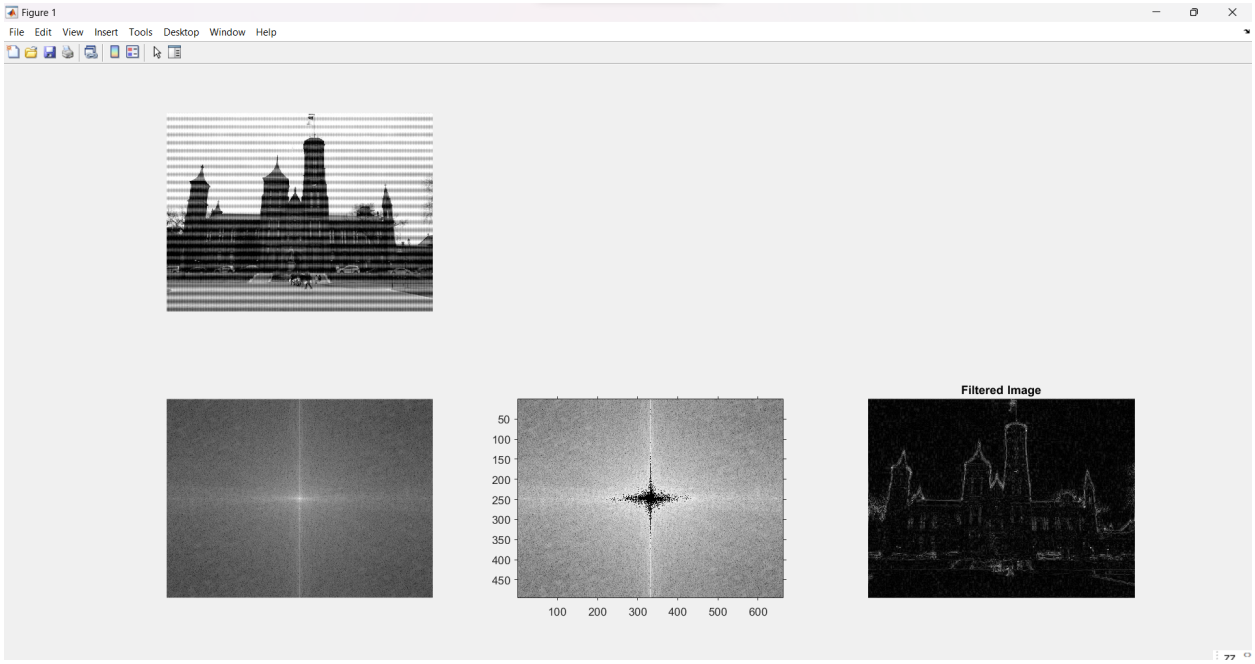
400
500
100
200
300
400
500



iii. Analisa

Image masih belum berhasil di filter dengan baik, dikarenakan oleh parameter tuning dari filter masih buruk.

g. Dekonvolusi Motion Blurring

i. Kode Program

```
function motionbluringButtonPushed(app, event)
    inputImage = imread(app.FileInputnameEditField.Value)
    kernelSize = 20;
    angleDegrees = 45;

    motionBlurKernel = fspecial('motion', kernelSize, angleDegrees);

    blurredImage = imfilter(inputImage, motionBlurKernel, 'conv', 'circular');

    % Restorasi citra dengan penapis Wiener
    wnr1 = deconvwnr(blurredImage, motionBlurKernel, 0); %NSR = 0, tidak ada noise aditif

    title('Citra hasil restorasi');
    imshow(blurredImage, 'Parent', app.UIAxes);

    imshow(wnr1, 'Parent', app.UIAxes_2);


end
```

```
608 function blurredImage = motionBlur(inputImage, kernelSize, angleDegrees)
609
610     % Create a motion blur kernel
611     motionBlurKernel = fspecial('motion', kernelSize, angleDegrees);
612
613     % Apply motion blur to the input image using convolution
614     blurredImage = imfilter(inputImage, motionBlurKernel, 'conv', 'replicate');
615
616 end
617
618 function spek7()
619
620     grayImage = imread('image-032.bmp');
621
622     colorImage = imread('image-033.jpg')
623
624     inputImage = colorImage
625     % Define the motion blur kernel size and direction
626     kernelSize = 30;  % Adjust the size as needed
627     angleDegrees = 90;  % Adjust the angle of motion blur      You, 1 second ago • Uncommitte
628
629     % Apply motion blur to the input image using convolution
630     blurredImage = motionBlur(inputImage, kernelSize, angleDegrees)
631
632     % Display the original and blurred images
633     subplot(1, 2, 1);
634     imshow(inputImage);
635     title('Citra Asli');
636
637     subplot(1, 2, 2);
638     imshow(blurredImage);
639     title('Citra dengan motiion blur');
640
641
642     imwrite(blurredImage, "tempBlurredImage.jpg");
643
644 end
```

ii. Hasil Eksekusi

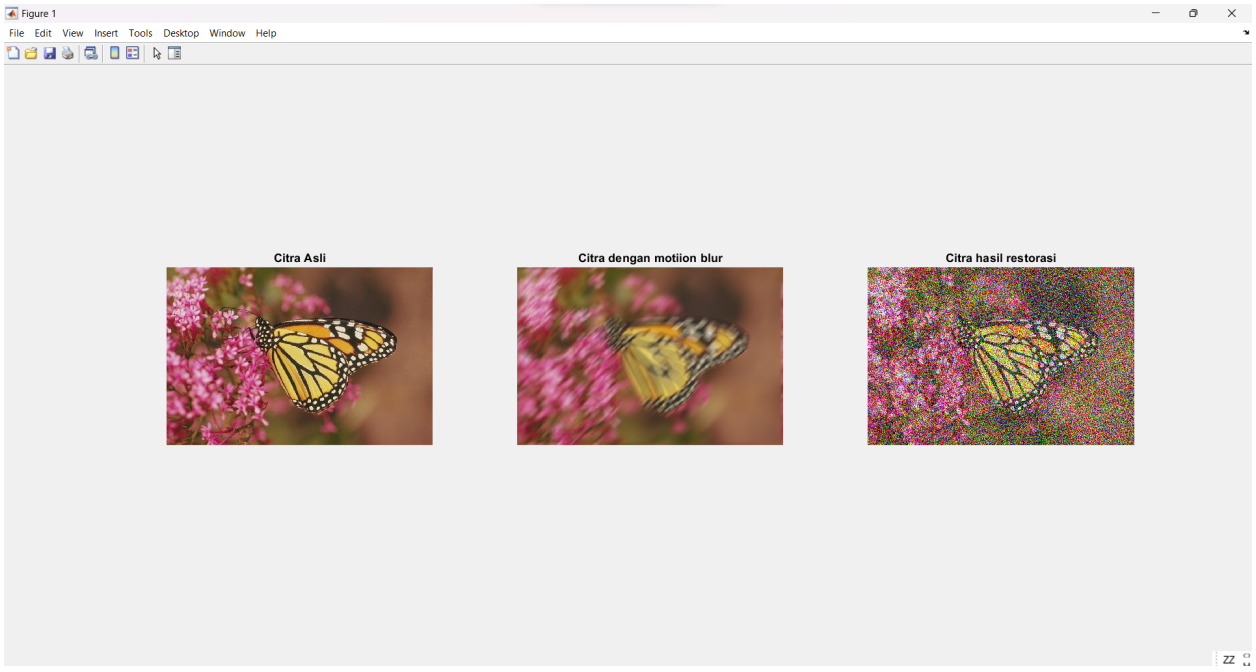


Figure 1
File Edit View Insert Tools Desktop Window Help
Citra Asli
Citra dengan motiion blur
Citra hasil restorasi

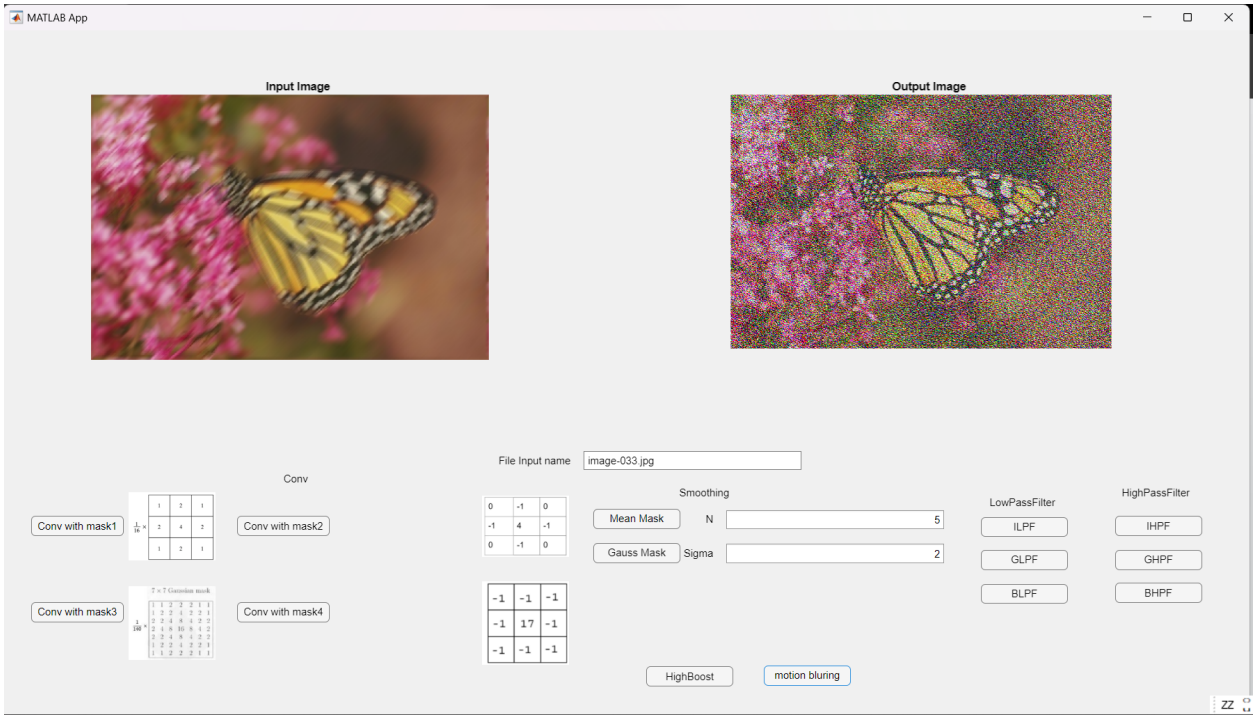

MATLAB App
Input Image
Output Image
Conv
Conv with mask1
Conv with mask2
Conv with mask3
Conv with mask4
File Input name
image-033.jpg
Smoothing
Mean Mask
N
5
Gauss Mask
Sigma
2
LowPassFilter
ILPF
GLPF
BLPF
HighPassFilter
IHPF
GHPF
BHPF
HighBoost
motion bluring

Figure 1

File Edit View Insert Tools Desktop Window Help

Citra Asli

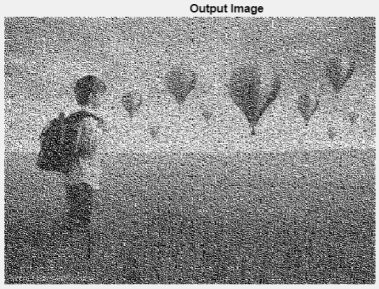
Citra dengan motiion blur

Citra hasil restorasi

MATLAB App

Input Image

Output Image



File Input name image-032.bmp

Conv

Conv with mask1

Conv with mask2

Conv with mask3

Conv with mask4

Smoothing

Mean Mask N 5

Gauss Mask Sigma 2

HighBoost

motion bluring

LowPassFilter

ILPF

GLPF

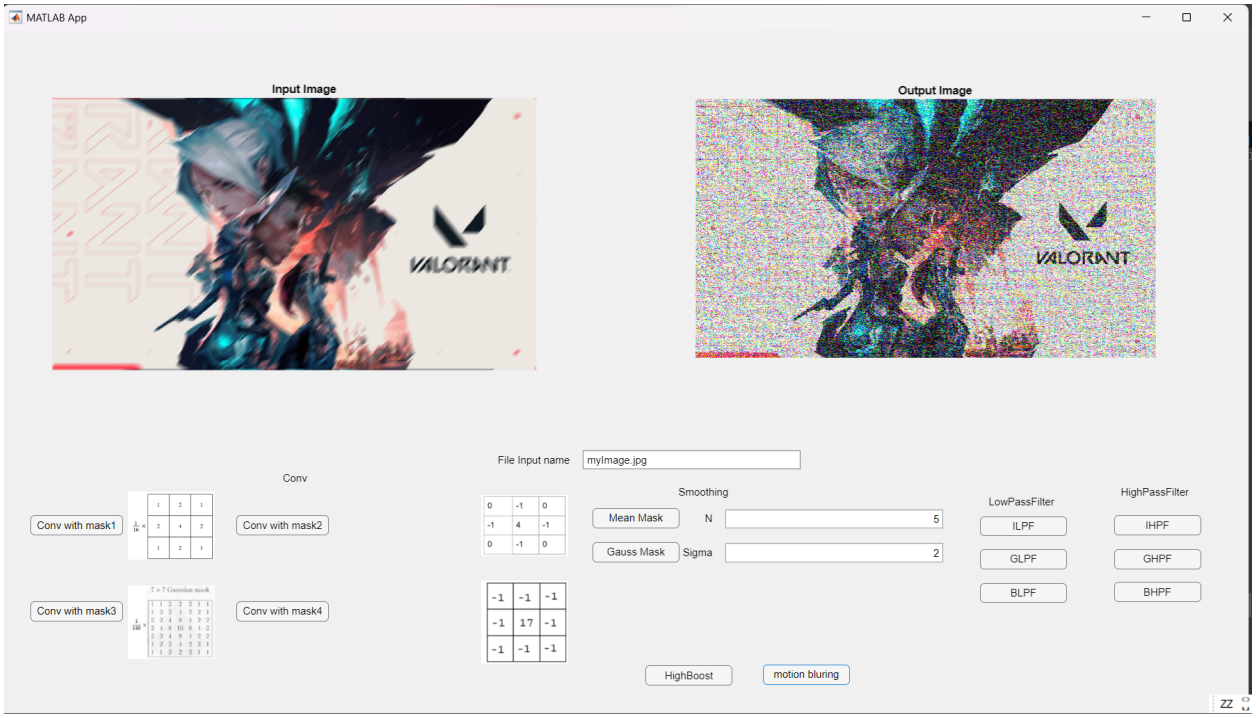
BLPF

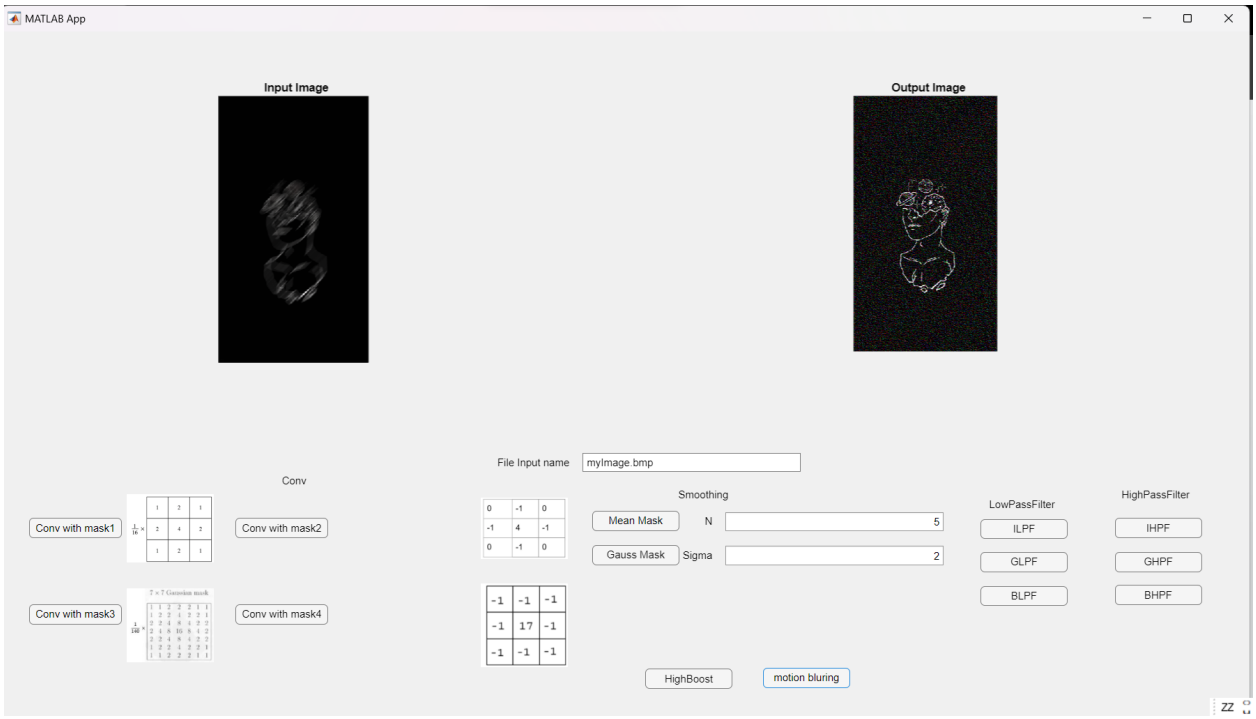
HighPassFilter

IHPF

GHPF

BHPF





iii. Analisa

Algoritma berhasil menghilangkan motion blurring walaupun menghasilkan bentuk derau lainya.

3. Alamat Github

https://github.com/ronggurmahendra/Tugas2-Citra-2023.git