Project 03

Problem 1

There is a GUI through which the user can interact with the program to select images, Region of interest and the locations for blending.
The readme file has been attached and the GUI also has instructions written on it.
Select Source and Target location buttons are used to calculate the vector used to align the source and target images. This can be treated as a user input where user points out the location of target and source if he desires specific areas to be blended.
Number of layers can be entered in the text box and the Select ROI button group can be used to select the desired Region of interest the user desires to make for mask creation.

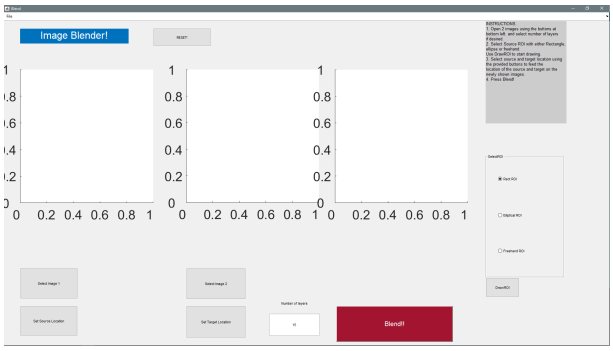


Figure 1: Example 1

```
function varargout = Blend(varargin)
% BLEND MATLAB code for Blend.fig
%      BLEND, by itself, creates a new BLEND or raises the existing
%      singleton*.
%
%      H = BLEND returns the handle to a new BLEND or the handle to
%      the existing singleton*.
%
%      BLEND('CALLBACK',hObject,eventData,handles,...) calls the local
%      function named CALLBACK in BLEND.M with the given input arguments.
%
%      BLEND('Property','Value',...) creates a new BLEND or raises the
%      existing singleton*.  Starting from the left, property value pairs are
%      applied to the GUI before Blend_OpeningFcn gets called.  An
%      unrecognized property name or invalid value makes property application
%      stop.  All inputs are passed to Blend_OpeningFcn via varargin.
%
%      *See GUI Options on GUIDE's Tools menu.  Choose "GUI allows only one
%      instance to run (singleton)".
%
% See also: GUIDE, GUIDATA, GUIHANDLES

% Edit the above text to modify the response to help Blend

% Last Modified by GUIDE v2.5 13-Nov-2019 11:25:45

% Begin initialization code - DO NOT EDIT
gui_Singleton = 1;
gui_State = struct('gui_Name',       mfilename, ...
                   'gui_Singleton',  gui_Singleton, ...
                   'gui_OpeningFcn', @Blend_OpeningFcn, ...
                   'gui_OutputFcn',  @Blend_OutputFcn, ...
                   'gui_LayoutFcn',  [] , ...
```

```
                   'gui_Callback',   []);
if nargin && ischar(varargin{1})
    gui_State.gui_Callback = str2func(varargin{1});
end

if nargout
    [varargout{1:nargout}] = gui_mainfcn(gui_State, varargin{:});
else
    gui_mainfcn(gui_State, varargin{:});
end
% End initialization code - DO NOT EDIT

% --- Executes just before Blend is made visible.
function Blend_OpeningFcn(hObject, eventdata, handles, varargin)
% This function has no output args, see OutputFcn.
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
% varargin   command line arguments to Blend (see VARARGIN)

% Choose default command line output for Blend
handles.output = hObject;

% Update handles structure
guidata(hObject, handles);

% This sets up the initial plot - only do when we are invisible
% so window can get raised using Blend.
if strcmp(get(hObject,'Visible'),'off')
%     plot(rand(5));
end

% UIWAIT makes Blend wait for user response (see UIRESUME)
% uiwait(handles.figure1);


% --- Outputs from this function are returned to the command line.
function varargout = Blend_OutputFcn(hObject, eventdata, handles)
% varargout  cell array for returning output args (see VARARGOUT);
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Get default command line output from handles structure
varargout{1} = handles.output;

% --------------------------------------------------------------------
function OpenMenuItem_Callback(hObject, eventdata, handles)
% hObject    handle to OpenMenuItem (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
file = uigetfile('*.fig');
if ~isequal(file, 0)
    open(file);
end
% --- Executes on button press in Img1.
% --- read images selected by the user
function Img1_Callback(hObject, eventdata, handles)
% hObject    handle to Img1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
    [img1, path1, ~] = uigetfile('*.jpg; *.png; *.jpeg', 'Pick a source image');
    if ~isequal(img1, 0)
        fg = im2double(imread(horzcat(path1,img1)));
    end
```

```
    axes(handles.Source);
    cla;
    fg1 = fg;
    hObject.UserData = fg;
    imshow(fg)

% --- Executes on button press in Img2.
% --- read images selected by the user
function Img2_Callback(hObject, eventdata, handles)
% hObject    handle to Img2 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
    [img2, path2, ~] = uigetfile('*.jpg; *.png; *.jpeg', 'Pick a source image');
    if ~isequal(img2, 0)
        bg = im2double(imread(horzcat(path2,img2)));
    end
    axes(handles.Target);
    cla;
    imshow(bg)
    hObject.UserData = bg;

% --- Executes during object creation, after setting all properties.
function Img2_CreateFcn(hObject, eventdata, handles)
% hObject    handle to Img2 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called


% --- Executes on button press in Rect.
% --- select rectangular ROI
function Rect_Callback(hObject, eventdata, handles)
% hObject    handle to Rect (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
    el = findobj('Tag', 'Ellipse');
    fr = findobj('Tag', 'FreeHnd');
    crt = findobj('Tag', 'DrawROI');
    axes(handles.Source);
    try
        roi = crt.UserData{3};
        delete(roi);
    catch
    end
    el.Value=0;
    fr.Value=0;


% --- Executes on button press in Ellipse.
% --- select elliptical ROI
function Ellipse_Callback(hObject, eventdata, handles)
% hObject    handle to Ellipse (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
    re = findobj('Tag', 'Rect');
    fr = findobj('Tag', 'FreeHnd');
    crt = findobj('Tag', 'DrawROI');
    axes(handles.Source);
    try
        roi = crt.UserData{3};
        delete(roi);
    catch
    end
    re.Value=0;
    fr.Value=0;

```

```
% --- Executes on button press in FreeHnd.
% --- select freehand ROI
function FreeHnd_Callback(hObject, eventdata, handles)
% hObject    handle to FreeHnd (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
    re = findobj('Tag', 'Rect');
    el = findobj('Tag', 'Ellipse');
    crt = findobj('Tag', 'DrawROI');
    axes(handles.Source);
    try
        roi = crt.UserData{3};
        delete(roi);
    catch
    end
    re.Value=0;
    el.Value=0;

% --- Executes on button press in Blnd.
% --- Blend the selected images based on selected ROI
function Blnd_Callback(hObject, eventdata, handles)
% hObject    handle to Blnd (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
    h1 = findobj('Tag', 'Img1');
    h2 = findobj('Tag', 'Img2');
    nl = findobj('Tag', 'nlayers');
    msk = findobj('Tag', 'DrawROI');
    trg = findobj('Tag', 'SetTrgtLocn');
    bg = h2.UserData;
    try
        fg1 = trg.UserData{1};
        bw_mask = trg.UserData{2};
    catch
        fg1 = msk.UserData{1};
        bw_mask = msk.UserData{2};
    end
    %handle RGB images.
    if size(bg,3)>1
        blendedImg(:,:,1) = blendPyramid(fg1(:,:,1),bg(:,:,1),bw_mask,str2double(nl.String));
        blendedImg(:,:,2) = blendPyramid(fg1(:,:,2),bg(:,:,2),bw_mask,str2double(nl.String));
        blendedImg(:,:,3) = blendPyramid(fg1(:,:,3),bg(:,:,3),bw_mask,str2double(nl.String));
    else
        blendedImg(:,:,1) = blendPyramid(fg1(:,:,1),bg(:,:,1),bw_mask,str2double(nl.String));
    end
%     blendedImg = ScaleRGBValues(blendedImg);
    axes(handles.Source);
    imshow(h1.UserData);
    axes(handles.Target);
    imshow(bg);
    axes(handles.Outputs);
    imshow(blendedImg);
    imwrite(blendedImg, 'blend.png');

% --- Executes on button press in SetTrgtLocn.
function SetTrgtLocn_Callback(hObject, eventdata, handles)
% hObject    handle to SetTrgtLocn (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
    droi = findobj('Tag', 'DrawROI');
    fgp = droi.UserData{1};
    bwm = droi.UserData{2};
    src = findobj('Tag', 'SetSrcLocn');
    axes(handles.Target);
    trgtLoc = drawrectangle();
```

```
    trgtPos = trgtLoc.Position;
    try
        srcPos = src.UserData;
        transVec = trgtPos(1:2)-srcPos(1:2);
    catch
        transVec = [0,0];
    end
    %translate image to location selected by the user.
    fgp=imtranslate(fgp, transVec);
    bwm = imtranslate(bwm, transVec);
    axes(handles.Source);
    imshow(fgp);
    axes(handles.Outputs);
    imshow(bwm);
    hObject.UserData{1} = fgp;
    hObject.UserData{2} = bwm;
    imwrite(bwm, 'mask.png');
    imwrite(fgp, 'fgPadded.png');
    delete(trgtLoc);

% --- Executes on button press in SetSrcLocn.
function SetSrcLocn_Callback(hObject, eventdata, handles)
% hObject    handle to SetSrcLocn (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
    axes(handles.Source);
    srcLoc = drawrectangle();
    srcPos = srcLoc.Position;
    hObject.UserData = srcPos;
    delete(srcLoc);

function nlayers_Callback(hObject, eventdata, handles)
% hObject    handle to nlayers (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: get(hObject,'String') returns contents of nlayers as text
%        str2double(get(hObject,'String')) returns contents of nlayers as a double

% --- Executes during object creation, after setting all properties.
function nlayers_CreateFcn(hObject, eventdata, handles)
% hObject    handle to nlayers (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: edit controls usually have a white background on Windows.
%       See ISPC and COMPUTER.
if ispc && isequal(get(hObject,'BackgroundColor'), get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end


% --- Executes on button press in DrawROI.
% --- draw ROI based on selected region type

function DrawROI_Callback(hObject, eventdata, handles)
% hObject    handle to DrawROI (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
    h1 = findobj('Tag', 'Img1');
    h2 = findobj('Tag', 'Img2');
    re = findobj('Tag', 'Rect');
    el = findobj('Tag', 'Ellipse');
    fr = findobj('Tag', 'FreeHnd');
    src = findobj('Tag', 'SetSrcLocn');
```

```
294     trg = findobj('Tag', 'SetTrgtLocn');
295     fg1 = trg.UserData;
296     if isempty(fg1)
297         fg1 = h1.UserData;
298     end
299     bg = h2.UserData;
300     axes(handles.Source);
301     if re.Value == 1 && el.Value == 0 && fr.Value == 0
302         [fg1, roi, bw_mask] = createROIMask(fg1, bg, 1);
303     elseif re.Value == 0 && el.Value == 1 && fr.Value == 0
304         [fg1, roi, bw_mask] = createROIMask(fg1, bg, 2);
305     else
306         [fg1, roi, bw_mask] = createROIMask(fg1, bg, 3);
307     end
308     axes(handles.Outputs);
309     imshow(bw_mask);
310     axes(handles.Source);
311     imshow(fg1);
312     imwrite(bw_mask, 'mask.png');
313     imwrite(fg1, 'fgPadded.png');
314     hObject.UserData{1} = fg1;
315     hObject.UserData{2} = bw_mask;
316     hObject.UserData{3} = roi;
317
318
319 % --- Executes on button press in Reset.
320 function Reset_Callback(hObject, eventdata, handles)
321 % hObject    handle to Reset (see GCBO)
322 % eventdata  reserved - to be defined in a future version of MATLAB
323 % handles    structure with handles and user data (see GUIDATA)
324     close(Blend);
325     run('Blend');
```

Code 1: GUI.m - created with GUIDE

a) Calculation of Gaussian and Laplacian Pyramid.
The Laplacian and Gaussian Pyramid computation is done as follows

Result: Gaussian and Laplacian Pyramid
Set base layer of gaussian pyramid as original;
while *layer less than numLayers and layerSize greater than 1* **do**
  gpyr(next) = gpyr(prev)-smooth(downscale(gpyr(prev)));
end
lpyr(top) = gpyr(top);
while *layer greater than 1* **do**
  lpyr(prev) = gpyr(prev)-smooth(upscale(gpyr(curr)))
end

Algorithm 1: Gaussian/ Laplacian Pyramid calculation

The Gaussian Kernel is calculated using the fspecial function from Matlab. The function accepts sigma(variance) and k(kernel size) as arguments, which are calculated as follows.

$$\sigma = \frac{(2 * downscale)}{6}$$

$$k = int(truncate * \sigma + 0.5)$$

Truncate taken to be 4.0 by default.
We can tune the hyper-parameter downscale to get desired results. This can be taken as a heuristic approach to finding the optimum window size.
As the transition while blending depends on the variance and kernel size of the Gaussian filter. It is important to tune these parameters to get a smooth transition.
The Gaussian pyramid of the mask is taken to ensure a smooth transition between the 2 images.
The optimum transition window for alpha depends on the maximum frequencies of the images A and B. The

above approach can be considered as a heuristic way to find out optimum kernel size by tuning hyper-parameters of the spatial domain gaussian kernel.

```
function [gPyr,lPyr] = ComputePyr(img1, num_layers)
%GENGAUSSIANPYR Galculate Gaussian and Laplacian Pyramids of the image.
%   Calculate the Gaussian and Laplacian Pyramid based on the number of
%   layers provided by the user/ till max possible layers (last layer being
%   1x1)

    layer = 1;
    %generate gaussian kernel
    dscale = 2.5;
    sigm = (2*dscale)./6;
    kernS = floor(4*sigm+0.5);
    h = fspecial('gaussian', kernS ,sigm);
%     h = ([1;4;6;4;1]*[1 4 6 4 1])./256; %can be implemented as a
%     separable filter as shown

    %set the initial layer as the original image.
    gPyr{layer} = img1;
    %while size of pyramid is greater than 1x1 & greater than layers
    %specified.

    %can view the pyramids by uncommenting the imshow and figure functions.
    %Takes up a lot of time.
    while(sum(size(gPyr{layer}))~=2 && layer<=num_layers)
        %smoothen and downscale
        gPyr{layer+1} = conv2d(gPyr{layer}, h, 3);
        gPyr{layer+1} = downscale(gPyr{layer+1},0.5);
        layer = layer+1;
%         figure;
%         imshow(gPyr{layer});
    end
    lPyr{layer}=gPyr{layer};
    while layer>1
        lPyr{layer-1} = gPyr{layer-1}-conv2d(upscale(gPyr{layer},size(gPyr{layer-1})), h, 3);
%         figure;
%         imshow(lPyr{layer});
        layer = layer-1;
    end
end
```

Code 2: ComputePyr.m - Compute gaussian and laplacian pyramids

Helper functions

Nearest Neighbor interpolation performed to upscale and downscale images through the pyramids. The upscale function uses newSize as argument to avoid dimension mismatch while blending the images. (Happens Due to integer rounding)

```
function [ResampledImage] = upscale(InputImage,newSize)
%UPSCALE used to upscale image to selected size
%   newSize taken as input to avoid mismatch of dimensions while moving
%   through the pyramid.
oldSize = size(InputImage);
scale = newSize./oldSize;

% nearest neighbor interpolation.
% calculate the new row and column indices for assignment of pixels
%subtract -0.5 to consider center of pixel. Add 0.5 to negate subtraction
%min function used to avoid any overflows
rowIndices = min(round(((1:newSize(1))-0.5)./scale(1)+0.5), oldSize(1));
colIndices = min(round(((1:newSize(2))-0.5)./scale(2)+0.5), oldSize(2));
%assignment based on the newly calculated indices
ResampledImage = InputImage(rowIndices, colIndices,:);
end
```

Code 3: Upscale

```
function [ResampledImage] = downscale(InputImage, ScalingFactor)
%IMRESAMPLE Resample image according to the given input
%   Resize the given image according to the given scaling factor, implement
%   nearest neighbor interpolation while upsampling to sample the images.

scale = [ScalingFactor, ScalingFactor];
oldSize = size(InputImage);
newSize = max(floor(scale.*oldSize(1:2)),1); %to avoid 0 index error
% nearest neighbor interpolation.
% calculate the new row and column indices for assignment of pixels
rowIndices = min(round(((1:newSize(1))-0.5)./scale(1)+0.5), oldSize(1));
colIndices = min(round(((1:newSize(2))-0.5)./scale(2)+0.5), oldSize(2));
ResampledImage = InputImage(rowIndices, colIndices,:);
end
```

Code 4: Downscale

Convolution and Padding functions from project 2 used. The convolution can be performed as a separable 1D convolution using 2 loops instead of nested loops which can improve the performance by a tad bit. In this case the convolution is with 3x3 gaussian filters generated with the fspecial command, hence the same function can be used to perform the convolution.
Moreover, a faster approach can be moving to frequency domain, and multiplying and again moving back to spatial domain.

```
function [op_img] = conv2d(img,kern, pad)
%CONV2 perform 2d convolution of an image with given kernel
%   Perform 2d convolution of an image.
    [r,c] = size(img);
    [rk, ck] = size(kern);
    img_pad = SetPadding(img, kern, pad);
    op_img = img;
    if rk==1 && ck==2 %special case, horizontal derivative.
        for i = 2:r+1
            for j = 2:c+1
                op_img(i-1,j-1) = img_pad(i-1,j-1).*kern(1,1)+ img_pad(i-1,j).*kern(1,2) ;
            end
        end
    elseif rk==2 && ck==1 %special case vertical derivative.
        for i = 2:r+1
            for j = 2:c+1
                op_img(i-1,j-1) = img_pad(i-1,j-1).*kern(1,1)+ img_pad(i,j-1).*kern(2,1) ;
            end
        end
    elseif not(mod(rk,2) && mod(ck,2)) %even sized kernels (eg. 2x2, 4x4...)
        for i = 1:r
            for j = 1:c
                for k = 1:rk
                    for l = 1:ck
                        su(k,l) = img_pad(i+k-1,j+l-1).*kern(k,l);
                    end
                end
                op_img(i,j) = sum(sum(su));
            end
        end
    else %for odd sized kernels (3x3, 5x5...)
        for i = ceil(rk/2):r+1
            for j = ceil(ck/2):c+1
                for k = -floor(rk/2):floor(rk/2)
                    for l = -floor(ck/2):floor(ck/2)
```

```
                        su(k+ceil(rk/2),l+ceil(ck/2)) = img_pad(i+k,j+l).*kern(k+ceil(rk/2),l+
    ceil(ck/2));
                    end
                end
                op_img(i-1,j-1) = sum(sum(su));
            end
        end
    end
end
```

Code 5: Convolution of image

As with any convolution this requires padding of the image to handle edges and corners. The padding code from project 2 has been modified to handle all odd kernel sizes and exceptions as 1x1 and 2x1 image sizes.
The padding code SetPadding.m has been attached in the .zip which can handle the all 4 types of padding. b) Create binary mask - Rectangular, Elliptical or Freeform. The image resizing and padding has been handled. The user needs to point out source and target location wherever required to align the faces/ source-target pair properly.

```
function [fgo, roi, bw_mask1] = createROIMask(fg, bg, roitype)
%CREATEMASK Create Mask based on ROI type and returns the resized image
% and mask
%   Returns the padded image and mask based on the selected ROI. The user
%   has 3 options - rectangular, elliptical and freeform.
    %check roitype
    if(roitype == 1)
        roi = drawrectangle('Label', 'ROI', 'color', [1 0 0]);
    elseif(roitype == 2)
        roi = drawellipse('Label', 'ROI', 'color', [1 0 0]);
    else
        roi = drawfreehand('Label', 'ROI', 'color', [1 0 0]);
    end
    %create mask from the selected ROI
    bw_mask = createMask(roi);
    [rb, cb, bch] = size(bg);
    [rf, cf, fch] = size(fg);
    %resize/ pad fg based on its original size.
    if(rf*cf>rb*cb)
        fgo=upscale(fg, [rb,cb,bch]);
        bw_mask1 = upscale(bw_mask, [rb,cb]);
    elseif(rf*cf<rb*cb)
        fgo = zeros(rb,cb,bch);
        bw_mask1 = zeros(rb,cb);
        if rf<rb && cf<cb
            % center the smaller fg and its mask by zero padding to bg size
            fgo(floor(rb/2)+(1:rf)-floor(rf/2), floor(cb/2)+(1:cf)-floor ...
                (cf/2),:) = fg;
            bw_mask1(floor(rb/2)+(1:rf)-floor(rf/2), floor(cb/2)+(1:cf)- ...
                floor(cf/2)) = bw_mask;
        elseif rf<rb && cf>cb
            fac = 1-((cf-cb)/cb);
            fg = downscale(fg,fac);
            bw_mask = downscale(bw_mask,fac);
            [rf, cf, fch] = size(fg);
            % center the smaller fg and its mask by zero padding to bg size
            fgo(floor(rb/2)+(1:rf)-floor(rf/2), floor(cb/2)+(1:cf)-floor ...
                (cf/2),:) = fg;
            bw_mask1(floor(rb/2)+(1:rf)-floor(rf/2), floor(cb/2)+(1:cf)- ...
                floor(cf/2)) = bw_mask;
        elseif rf>rb && cf<cb
            fac = 1-((rf-rb)/rb);
            fg = downscale(fg,fac);
            bw_mask = downscale(bw_mask,fac);
            [rf, cf, fch] = size(fg);
```

```
            % center the smaller fg and its mask by zero padding to bg size
            fgo(floor(rb/2)+(1:rf)-floor(rf/2), floor(cb/2)+(1:cf)-floor ...
                (cf/2),:) = fg;
            bw_mask1(floor(rb/2)+(1:rf)-floor(rf/2), floor(cb/2)+(1:cf)- ...
                floor(cf/2)) = bw_mask;
        end
    else
        fgo = fg;
        bw_mask1 = bw_mask;
    end
end
```

Code 6: CreateROIMask.m Subroutine to create Mask

c) Blending of images and alignment.
The blending can be treated as α blending where the α can be taken as the Gaussian pyramid of the mask. The formula for blending can be taken as follows
$blendedImg(i) = lPyrA(i) * gPyr(i) + (1 - gPyr(i)) * lPyrB(i)$
We do the operations layer by layer and then collapse the pyramid.

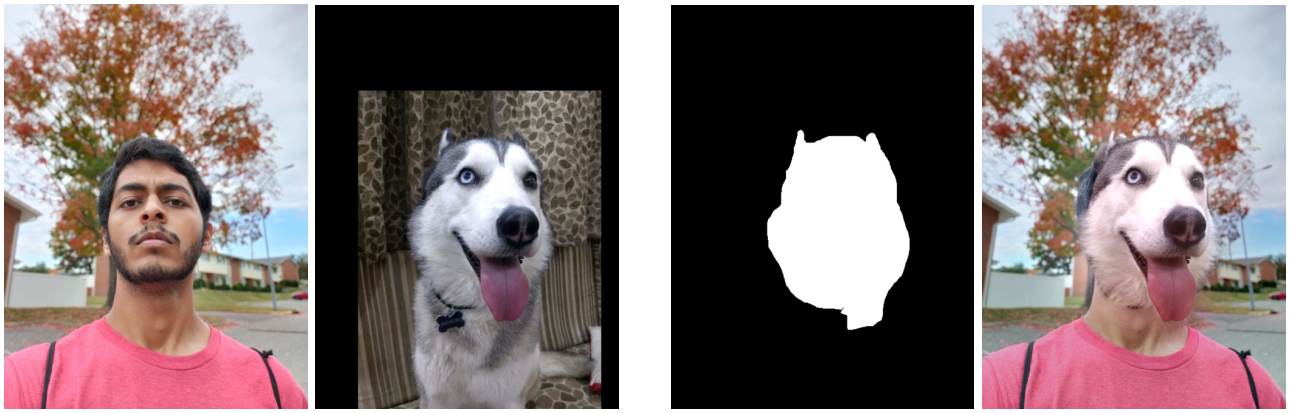
```
function [blendedImg] = blendPyramid(bg, fg, bw_mask, nlayers)
%BLENDPYRAMID blend the pyramid based on selected bg fg and mask.
%   Calculates the Laplacian Pyramids of images and Gaussian Pyramid of the
%   mask and does alpha blending to get the blended pyramid. Then collapses
%   the pyramid to recover the blended image.
    [~, lPyrBG] = ComputePyr(bg, nlayers); %calculate laplacian pyr of 1st img
    [~, lPyrFG] = ComputePyr(fg, nlayers); %calculate laplacian pyr of 2nd img
    [gPyrMask,~] = ComputePyr(double(bw_mask), nlayers); %gaussian pyr of mask
    for i = 1:length(gPyrMask)
        %calculate blended pyramid based on alpha blending with mask gpyr
        lblend{i} = (gPyrMask{i}) .* lPyrBG{i} + (1-(gPyrMask{i})).*lPyrFG{i};
    end
    layer = length(lblend);
    %generate gaussian kernel
    dscale = 2.5;
    sigm = (2*dscale)./6;
    kernS = floor(4*sigm+0.5);
    h = fspecial('gaussian', kernS ,sigm);
%     h = ([1;4;6;4;1]*[1 4 6 4 1])./256; % can be implemented as separable
%     filter as shown

    %collapse pyramid
    while(layer>1)
        lblend{layer-1} = conv2d(upscale(lblend{layer}, size(lblend{layer-1})),h,3)+lblend{
    layer-1};
        layer = layer-1;
    end
    blendedImg = lblend{1};
end
```

Code 7: Blending of images

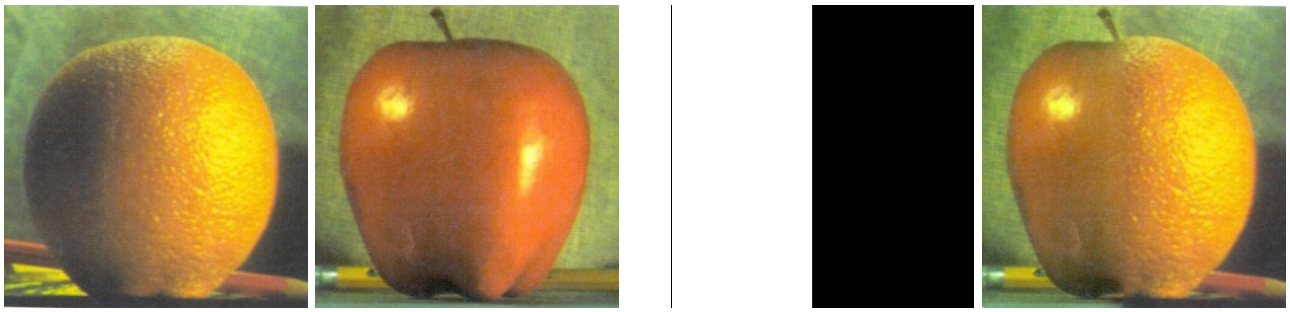
The codes are commented properly where required and the outputs are attached below

RESULTS



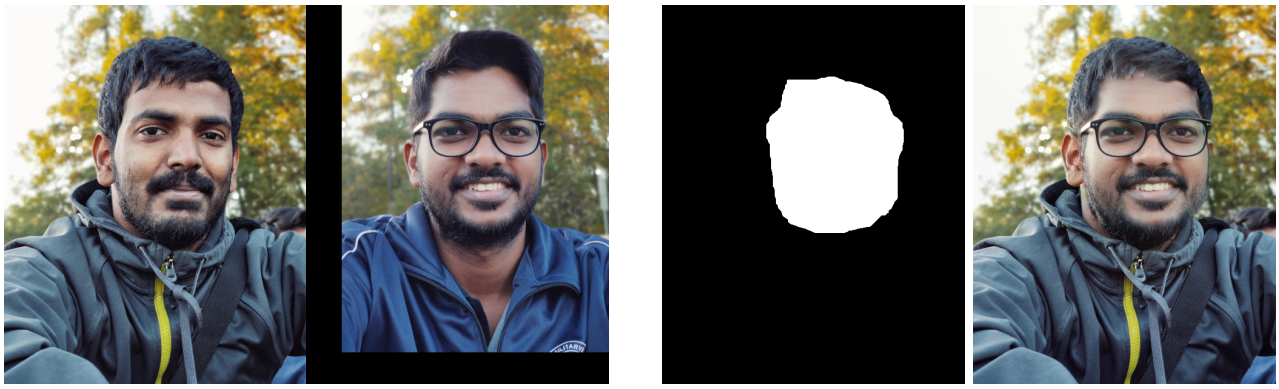
(a) Background Image (b) Foreground Image (c) Mask (d) Blended Image

Figure 2: Example 1



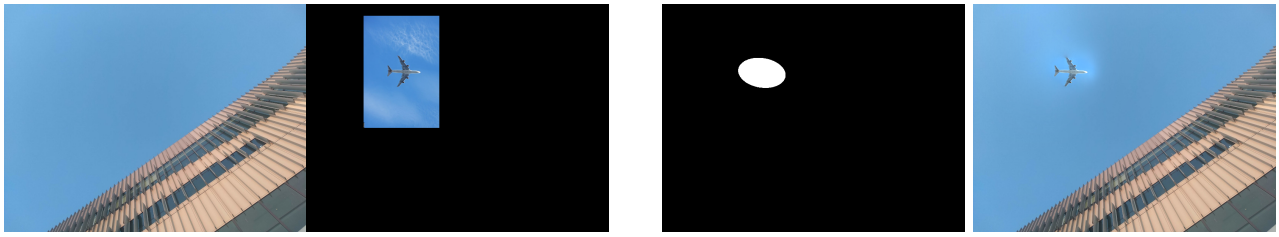
(a) Background Image (b) Foreground Image (c) Mask (d) Blended Image

Figure 3: Example 2



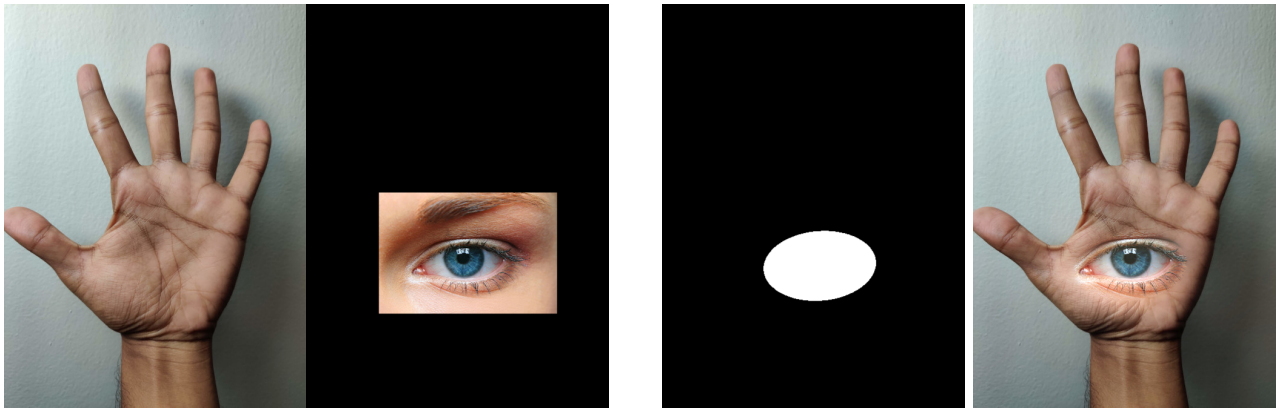
(a) Background Image (b) Foreground Image (c) Mask (d) Blended Image

Figure 4: Example 3



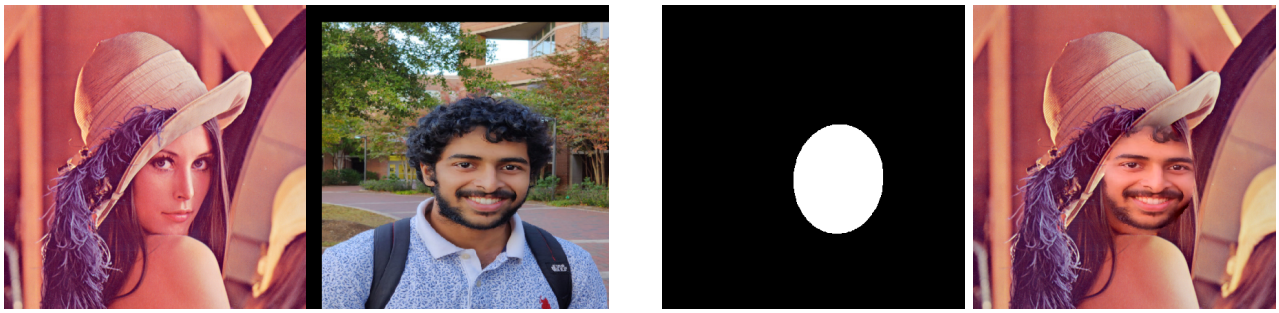
(a) Background Image (b) Foreground Image (c) Mask (d) Blended Image

Figure 5: Example 4



(a) Background Image (b) Foreground Image (c) Mask (d) Blended Image

Figure 6: Example 5



(a) Background Image (b) Foreground Image (c) Mask (d) Blended Image

Figure 7: Example 6