

Restoration of Human Face using Basic Image Processing Methods in MATLAB

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Abstract: *Images play a very pivotal role in our daily routine. A simple image will represent thousand words. So we can represent any information in the form of Images. But for representing of real world applications in the form of images there exists many constraints like memory, processing, efficiency, throughput etc., also when the complexity of an application increases, then processing of images will become a cumbersome task. There are many Image Processing Operations in existence, depending on the application we can use one or more operations. So I would like to enlighten the readers on various basic operations on images like Stitching, Mosaicing, Fusion, Contrast Adjustment, Edge Detection, Image Cropping, Image Sharpening and Image Blurring. But I would like to get into detail only on three operations - Image Stitching, Image Blurring and Image Edge Detection. The basic operations that are stated will have their own merits and demerits, but based on the requirement they will be implemented. Some operations discussed above may be implemented using Hybrid approach where two or more basic operations are merged to form a new approach. It was also discussed when the size of image increases then the operations stated may not give efficient results. So a comparative study was also made to overcome this issue. It was also discussed when the images are more in number and they need to be operated as a single image then there will be definitely time delay for getting an efficient result. Some images may be embedded with watermark or some may not be completely restored at a single instance, then we need to apply some transformation techniques to reconstruct the image and restore the original image or approximation of the original image to the level extent possible. Many open source tools are available to perform such operations and reconstruct the original image, but this needs to have a clear study on the operations and how to place the input and output parameters. In the real world scenarios in which a huge amount of database of images are available, then searching only is the constraint that will be there for the user. Once the images are selected and operations are applied on it, then the result actually simplifies the complete process of Reconstruction. We can also extend our discussion based on this study to a level where we can restrict to a Specific design of selecting and manipulating images automatically without any intervention of a user or an administrator.*

Keywords: Fusion, Stitching, Blurring, Image Processing, Edge Detection, MATLAB

1. Introduction

Image can be interpreted in different ways. For a doctor it is a valuable source of information about a patient, by which he can diagnose the reason for ill - health of that patient. For a Government Servant in Police department it may serve as a valuable clue for identifying a criminal. For a Scientist it may serve as a input for further analysis. For a Historian it could provide valuable information about the past. And for Researchers in this area it is just a piece of valuable information that helps them to get a clear idea of what needs to be enhanced to make it clearer, diagnose the image possibly about its origin and what can be done on it, analysis of image, valuable information and so on. The examples stated above are just for making it easy to understand and the real usage of Image may not be confined only to that specific area what was stated. In some areas it may also extend beyond to what was stated.

As a person's age increases as time passes on and probably his/her charm reduces as times moves on and they reaching old age. In the same way the images may also fade. In the initial days where there was no process of digitization then there is obviously a threat of losing images (not Physically). By this restriction and advancement of technology in various fields and especially in the field of image processing today was possible where everything was digitized. So there is no possibility of losing the images or reduction in quality of

images. There always lies a question that what we reached till now is it the end and definitely the answer from everyone will be No. Still we need to move on with new innovations. Based on this brief study what we analyzed we would like to get into the internal details of what actually the operations means to an image and what best can be done to restore images and enhance their quality.

The paper primarily focuses for larger data sets where some basic image processing operations are applied and based on the study of these basic operations the reverse process was applied, where we can construct the original image back. As in real world cases morphing is a general phenomenon done to modify images and here in this paper we tried to verify how that can be done and if it was done how to reverse the process to reconstruct the image. This has many applications but here we had focused on the criteria where if images are scrambled how to identify the original image. We tried to take some random pattern of images and apply basic operations on them, but for this study we focused only on a single image. Contrast Adjustment is a process that identifies the dissimilarities in two parts of an image and based on it a similar image is constructed. Edge Detection is a process where large image sets are available and if we are looking for similarity pattern at a single position or set of locations then based on this Edge Function we will try to reconstruct the missing regions leaving the edges and then form the completed image. Image Cropping is a process of selecting only a part of the image. Sharpening is a process of

Volume 12 Issue 5, May 2023

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adding some signal to the original image which makes it look like a better version of the original image probably with high resolution. Image Blurring is a process of making the image less clearer for human vision. Fusion is a mechanism where two or more images are combined to a single image based on some similarity pattern. This can be used where we can take an image from different views and try to construct the original image as viewed from the front. Stitching is a mechanism where different parts of an image are available then we will construct the image based on the probable locations of parts in the original image. Mosaicing as discussed previously is hybrid approach that maps stitching and contrasting to form an image of high quality or resolution.

2. Materials and Methods

We have studied a few basic operations on images as discussed above and we considered a human face and performed on it. For experimental study we took the help of MATLAB R2013a and measured the performance parameters using normal techniques and MATLAB and found that this MATLAB is giving better results compared to normal techniques. For convenience sake we have depicted only two operations results and gave the experimental results.

Stitching is another major image processing mechanism which deals with the process of combining multiple overlapping images into a single image without any distortion of the image properties. Computer vision is major discipline from which stitching was derived. The major aspect of stitching is to increase image resolution, mainly useful in topographic mappings. Image stitching produces a segmented panorama or high - resolution image. High dynamic Range is performed on the overlapped images in the regions of overlap for producing seamless results. Image stability feature in many of the recent camcorders perform the stitching property implicitly. Stitching can be defined as a reconstruction big images or stacks of images from an arbitrary number of tiled image sources on which Fourier shift theorem is applied for generating required translations.

Image stitching is broadly classified into three components namely image registration, calibration and blending. As illuminations may differ between interleaved images, the two images thus formed may end up with a visual seam. Consistent exposure is tried to be maintained between overlapping images to minimize the probability of seaming. For images that are laid in same point of space, map projections are used for arranging the stitched images. The process of stitching is able to align an arbitrary number of channels and supports for time - lapse registrations. Pair - wise and Grid or collection stitching are the major plug - in available.

The methodology applied for this process was Scale Invariant Feature Transform algorithm, where initially relevant information in both the images based on similar patterns will be identified and then a localization algorithm would run to join the edges followed by orientation of the edges of the two images. Finally the localized gradient points at each end will be determined to see if any shape

distortion in in existence and also to look for any change in illumination if needed.

Mathematically a simple illustration was stated where we have applied both translation and scaling on the object positions in order to see that both the images are mapped onto a single image and also they will look very identical when viewed as a Result. Assume a 3*3 Matrix for its transformation then it will be like

a_{11}	a_{12}	a_{13}
a_{21}	a_{22}	a_{23}
0	0	1

The main reason for applying such transformation is to see that both the coordinate positions of the images that are selected for stitching confronts as a single image with same dimensions. It was also argued that Panoramic view of an image also plays a key role for determining the stitching Operations, as a complete large screen may not fit on a camera lens when we actually try to fit as a single picture. In this case also the Panoramic view of an image will generate a realistic view of the image as if it is a single image. We will capture parts of a scene and apply the methodology as stated above and then we will get a realistic approach of the image as if it was directly captured by the camera. An ideal Image Stitching methodology must also support multiple image motions such as Rotation about a point or rotation about a plane. This also can be further extended to many realistic shapes like Cylinders, Spheres and Planar objects as well.

Next primary focus is on Edge Detection where we have analyzed three basic methods of Prewitt, Sobel and Robert. Before going into the detail part of the implementation of the basis of each of these methods let's get familiar with the term gradient as it forms the foundation for these methods. Gradient is generally defined as a directional change of the intensity value or color of a pixel position in an image. Image gradients are generally used to extract relevant information from the images. Let us consider a simple image with neighborhood as shown below.

w1	w4	w7
w2	w5	w8
w3	w6	w9

Sobel: In this method the gradient values are often detected using discrete differences between columns and rows of a 3*3 neighborhood. It was based on convolving the given image with a small, integer value and separable filter. Here the Gradient values are plotted as (G_x/G_y Values)

1/1	2/0	1/ - 1
0/2	0/0	0/ - 2
- 1/1	- 2/0	- 1/ - 1

Prewitt method is the oldest and standard method used for edge Detection. This uses a standard mask values for approximating the first derivatives of G_x and G_y values.

1/1	1/0	1/- 1
0/1	0/0	0/- 1
- 1/1	- 1/0	- 1/- 1

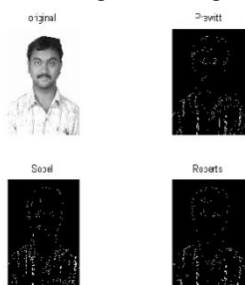
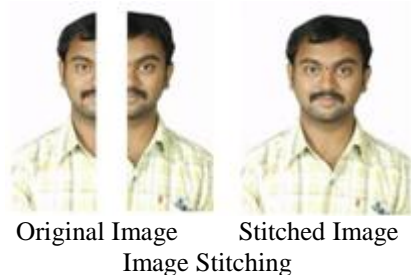
Robert method is also frequently used and the basic assumption in this method is that all the edges should be well defined and the image should not contribute much noise. The values to convolve over here are

1/0	0/1
0/- 1	- 1/0

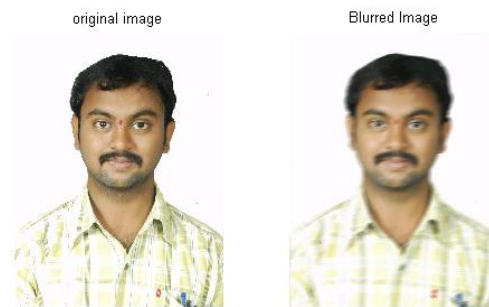
Image Restoration is an important phenomenon in image processing. In this paper we primarily focused on the technique of Image Blurring. We wanted to actually show the effect of Image Blurring, by various methods. Blur is generally known as an un sharp image area caused by improper focusing, object motion, camera movement or use of an aperture that gives a depth that is shallow. There is also one criteria of Motion Blur Phenomena where both the object of interest and camera are moved in parallel which makes the image to be blurred. There are various ways in which image can be blurred but in this paper we focused on the mechanism of average filter. The process here that was applied is very simple, at any pixel position the intensity value is replaced by a new intensity value by considering the neighboring pixel positions along with the current pixel position intensity value and computing the average. The resultant average value will be the new intensity value of the current pixel position. Assume the intensity values of all pixels are 1 then as per this Average Filter Technique which can also be referred as Mean Filter Technique the new intensity values are

1/9	1/9	1/9
1/9	1/9	1/9
1/9	1/9	1/9

3. Results



Edge Detection using Prewitt, Sobel and Roberts Methods



Blurring of Image

4. Discussion

In this paper the basic operations on Image Processing like stitching, Edge Detection and Blurring are discussed. Although there are many basic operations that could be done on images, we chose these as these are the basic things what will enlighten any beginner who has a bias to do research in Image Processing. Although the discussions and results depicted above are truly in existence but still they form a basis for our future research. Initially when any one wanted to perform some basic image operations then they used to perform them by iterative approach where they used to join picture patterns one by one for which accuracy may be a limitation. But when tools like MATLAB practically came into existence the task of performing these operations became very easy. Although many operations are practically in use we have taken the human face as a basis for these operations, the reason being it would be helpful to detect a human face using techniques from a large set of people and match the records with the available set of records. This will definitely be helpful when we capture a person's image from different views and then try to restore who the person was actually if some details are missing in the image. Even they can be stored for generations to come and we can get a person's record based on image available although it is not clearly legible.

5. Conclusion and Future Work

Based on the above discussions and methodologies used and results identified, we can say that MATLAB is a powerful tool for image operations. Many complex image operations can be simplified using MATLAB. Generally image operations need a thorough study on the process and when applied to perform certain operations then the complexity of the task would generally increase. When MATLAB was not in existence then the process for restoring image operations need to have a thorough study on methodologies and finally get the result. But MATLAB simplified that requirement. The time delay for this process although is found to be a bit less but this may not be suitable for applications where the image size is large. When many images with dissimilar patterns are available it may not be able to give efficient results. It may be also a difficult task to search for a particular pattern or set of images from the database. But still although certain limitations do exist it proved to give efficient results in terms of image Operations. We would like to extend this idea of Image Processing operations to an extent where it would give more efficient results than the

existing one. We would also like to perform the same of operations by considering the time factor as a parameter and compare the results. There are many more sophisticated operations in Image Processing which we did not cover in this paper, but definitely we would also like to measure the efficiency of such operations in the future as well. We also would like to store images on a central repository and using these basic operations we will reconstruct the image and try to compare the reconstructed image with those images that are available in the central repository and provide the details about the properties back to the user who made the request.

Acknowledgement

I am very thankful to DrP. Srinivasa Rao, Assoc Prof, MVGR College of Engineering who laid the foundation of this basic idea into my mind. I am very thankful to M. Jayasree, my project student who helped me in findings of the related work. I am also thankful to Mr T. Chaitanya Kumar, Asst Prof, MVGR College of Engineering for his un ended support.

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