Introduction To Computing

Project Report

on

DIGITAL IMAGE PROCESSING

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Submitted to

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Index

Topic Page No.

Acknowledgement……..3
Digital Image Processing……..4
Background……..5
Input Images……..6
Image on Scaled Axis……..7
Breaking Images into Individual Planes ……8
Gray-Scale Image……..9
Sepia/Noir Filter……..10
Reflection of Image……..11
Wiener Filter……..12
Edge Detection and Intensity Edge Detection..13
Face and Eye Detection……14
Applications……..16
References……..17

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We would like to thank you professor Dr. Ajeet Kumar for giving us an opportunity to research and study its application in more depth. His constant motivation and support helped us a lot.

Digital Image Processing

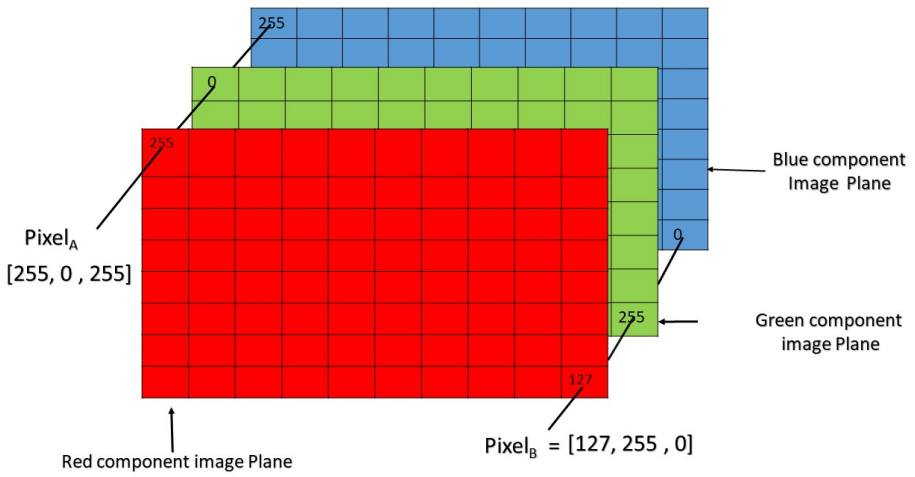
Digital image processing is the use of a digital computer to process digital images through an algorithm. digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modelled in the form of multidimensional systems. The generation and development of digital image processing are mainly affected by three factors: first, the development of computers; second, the development of mathematics (especially the creation and improvement of discrete mathematics theory); third, the demand for a wide range of applications in environment, agriculture, military, industry and medical science has increased.

Background

The smallest way to represent an image is its a grid of pixels (i.e. dots), each of which an be of different colour. An image is just a bitmap (i.e. map of bits). For colourful images we simply need more bits per pixel. A file format (like BMP, JPEG, or PNG) that supports "24-bit cooler" uses 24 bits per pixel. (BMP actually supports 1-, 4-, 8-, 16-, 24-, and 32-bit colour).

A 24-bit BMP uses 8 bits to signify the amount of red in a pixelA 24-bit BMP uses 8 bits to signify the amount of red in a pixel's colour, 8 bits to signify the amount of green in a pixel's colour, and 8 bits to signify the amount of blue in a pixel's colour. If you've ever heard of RGB colour, well, there you have it: red, green, blue.s colour, 8 bits to signify the amount of green in a pixel's colour, and 8 bits to signify the amount of blue in a pixel's color. If you've ever heard of RGB colour, well, there you have it: red, green, blue. Image processing is simply matrix manipulation

In matlab, RGB image can be viewed as three different images (a red scale image, a green scale image and a blue scale image) stacked on top of each other, and when fed into the red, green and blue inputs of a colour monitor, it produces a colour image on the screen. In MATLAB, an RGB image is basically a M*N*3 array of colour pixel, where each colour pixel is associated with three values which correspond to red, blue and green colour component of RGB image at a specified spatial location.

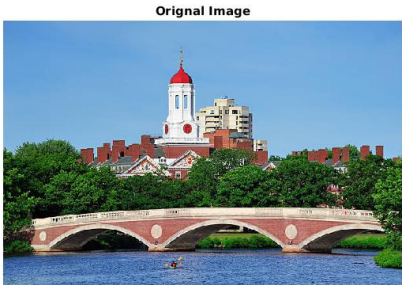


Pixel of an RGB image are formed from the corresponding pixel of the three component images

Input Images

This image is called face.jpg

This image is called bridge.jpg



This image is called image.jpg

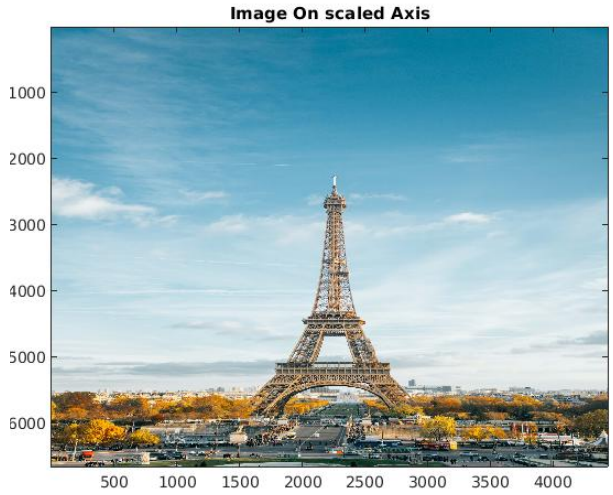
Image on scaled Axis

The imagesc() command displays the image on scaled axes .

the way to invoke the function

```
size_image = size(img_matrix);
figure
imagesc(img_matrix);
title('Image On scaled Axis');
```

the output of the image is



Uses of this method

This method of displaying the image on scaled axis is useful for finding integrate things about the image and their relations with image scenarios, extensively used in image forensics.

Breaking the image into individual planes

In matlab we can display the individual planes by simply outputting the image pixels and the plane we want as all the images are M*N*3

Output Images

Uses of this method

This type of image processing feature of displaying the various planes of the image separately is extensively employed in precision agriculture which helps to get sensitive information about the plant like vigour, growth, and which plant needs special attention this technique is deployed in modern agricultural drones.

Gray-Scale Image

In grayscale the pixels is assigned the average value of the pixels which are in around it for all the planes, which is then rounded off to the nearest number. This way the image is processed to an instagram like Gray-scale filter.

Output Image

Uses of this method

Gray Scale or black and white image has various uses from photographic effects to give nostalgic effect to the image. Other major use of grayscale image is in facial recognition because the image for facial recognition and other machine learning techniques is converted to grayscale, to reduce complexities, as we only have one plane then.

Sepia/Noir Filter

In sepia filter, the R,G,B values of a filter are modified using the sepia formula, which determines the new R,G,B values of each pixel.

The sepia formula is as follows

Sepia Red = 0.393*red + 0.769*green + 0.189*blue

Sepia Green = 0.349*red + 0.686*green + 0.186*blue

Sepia Blue = 0.272*red + 0.534*green + 0.131*blue

And if Sepia Red/ Sepia Green/ Sepia Blue values for any pixel is greater than 255 then the value is assigned to 255.

Output Image

Uses of this method

Sepia is a very famous filter available in modern social media filters, mobile filters. This filters give an old feel to the photo.

Reflection of an image

In reflection all the image pixel values are reversed in a matrix, because of which the image outputs as reflected about the horizontal axis.

Output Image

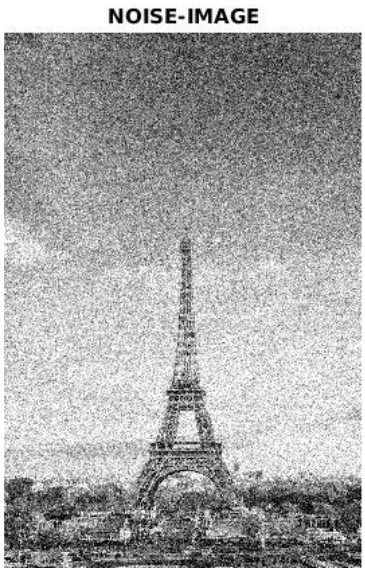
Uses of this method

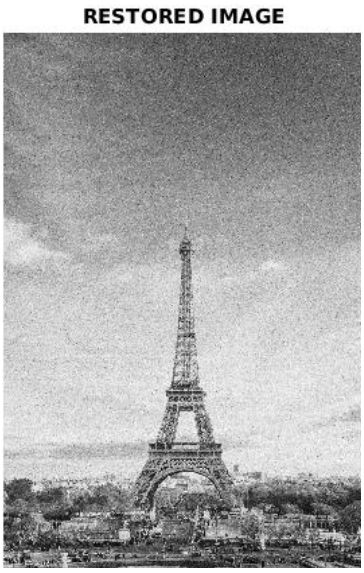
Reflection is yet another feature used in forensic imaging. It is used to investigate differences as well as features which are not very clear from one particular direction to view. It is also used for fun in modern image filters in most of the phones for kaleidoscopic effects.

Wiener Filter

It is a type of linear filter, which is used to remove noise from the images.The Wiener filter tailors itself to the local image variance. Where the variance is large, wiener2 performs little smoothing. Where the variance is small, wiener2 performs more smoothing. This approach often produces better
results than linear filtering. The adaptive filter is more selective than a comparable linear filter, preserving edges and other high-frequency parts of an image.

Output Images





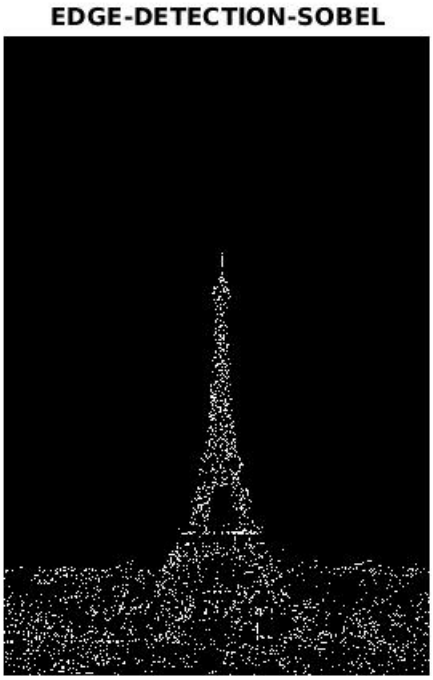
Uses

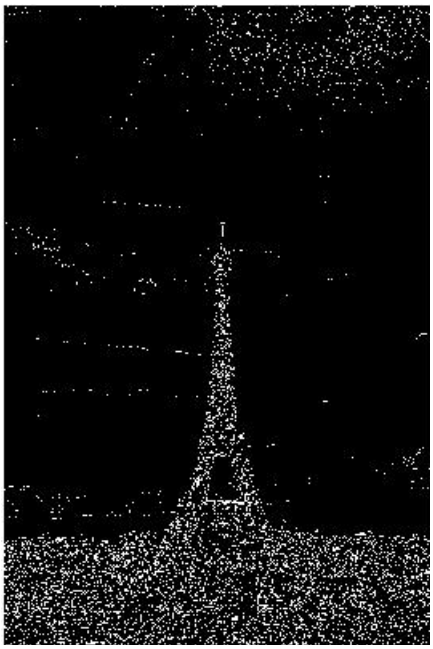
A prominent use is in image filtration for pulsars. As pulsars are in deep space and have very week radio signals, and thus can't be properly detected, by normal radio astronomy, so similar kind of filters are employed where multiple images of the same are stacked on top of each other and the median value, which are more accurate than mean values are taken to reduce the filter. Another important usage apart from astrophysics is in AI based robotic systems, which use similar algorithms, for image filtration. Also image filtration is used in Defence Systems and medical brain imaging.

Edge Detection and Intensity Edge Detection

Matlab's image processing toolbox provides with a number of inbuilt edge detection and intensity edge detection functions. The basic algorithm for the edge detection is the change in pixel values. The image is generally converted into gray scale first and then the sudden change in pixel values tell the edges of the object. The inbuilt functions used are Canny and Sobel in this project.

Output images





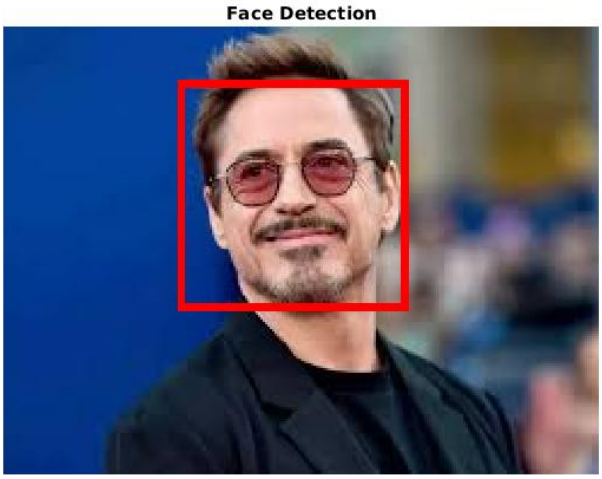
Uses

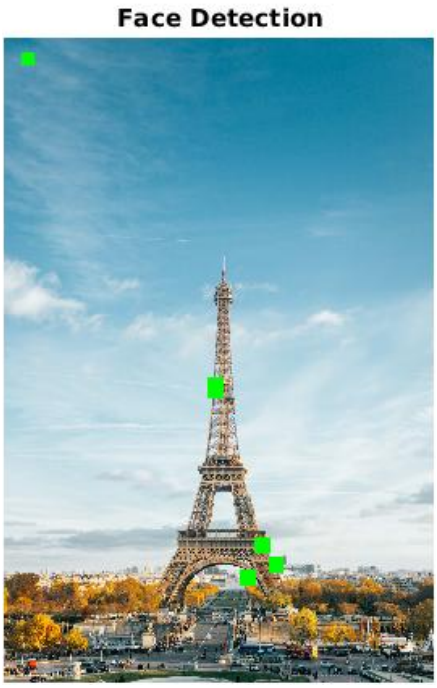
Edge Detection is important feature used in Robotics and intelligent systems in locomotory systems to for collision avoidance and military surveillance systems.

Face and Eye Detection

Matlab provides with opencv library, which provides many powerful features like facial recognition, eye recognition, upper body recognition, mouth recognition etc. The facial recognition in this project uses viola-jones algorithm. The viola jones algorithm is a convolutional neural network, which uses the logic that all human faces have common features like eyes, nose, mouth, ears etc called Haar features. The algorithm compares the input image with thousands of recognised Haar features and then classifies if the input image has a face and or eye or not.

Output images





Uses

Facial Detection and eye detection have various uses like security usages, photo-tagging, robotics and artificial intelligence and robotics for person detection in autonomous machines. Now-a-days it is also used for recreational purposes also.

Applications

Digital Image Processing has wide applications from deep space exploration activities to hobby photo-editing and applying special effects. The major applications are forrensic image processing, where rough and non-processable images are smoothen for processing and recognition examples include finger print detection. Another significant application is in medical sciences, where brain MRI images obtained which are very blurry are processed to see the desired features of the image. Security features also use digital image processing significantly for facial and eye scans, to verify the person. Image processing is a growing field and we are currently at the beginning of utilising features of image processing.

References

MIT-OCW

Digital Image Processing by Gonzalez and Woods

Matlab Image Processing Toolbox Documentation

Digital Image Processing using Matlab by Rafel C Gonzalez.