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Human Face Image Scaling using Interpolation Techniques

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Abstract:
Image scaling is the way toward resizing a computerized Image. Scaling is a non-trifling procedure that includes an exchange off between proficiency, smoothness and sharpness. The span of a Image is lessened or amplified, the pixels which involve the Image turn out to be progressively noticeable, making the Image seem delicate if pixels are arrived at the midpoint of, or spiked if not. Developing a Image is for the most part regular for making littler symbolism fit a greater screen in full screen mode. There are a few strategies for expanding the quantity of pixels that a Image contains, which levels out the presence of the first pixels

Keywords: HR (High Resolution), LR (Low Resolution), Interpolation

1. INTRODUCTION

Images area unit the foremost common and convenient means that of convincing or transmission data. They convey data regarding positions, sizes and inter-relationships between objects. They portray spatial data that may simply acknowledge. Folks area unit smart at derivation data from such Images, attributable to our innate visual and mental skills. Regarding seventy fifth of the knowledge received by human is in pictorial kind. These days capture Images area unit thrown digital media in digital kind. Zooming is said to resizing from Images to be ready to see a lot of detail, increasing resolution, victimization optics, printing techniques, or digital process.

1.1 Digital Images

An Digital image may be defined as a two dimensional function f(x, y) where x and y are spatial (plane) co-ordinates. The amplitude of 'f' at any pair of co-ordinate (x,y) is called the intensity 'or' gray level of the image at that point. Digital images are electronic representations of images that are stored on a computer. The most important thing to understand about digital images is that you can't see them and they don't have any physical size until they are displayed on a screen or printed on paper. Until that point, they are just a collection of numbers on the computer's hard drive that describe the individual elements of a picture and how they are arranged. These elements are called pixels (short for picture elements), and they are arranged in a grid format with each pixel containing information about its color or intensity.

1.2 Binary Image

A binary image is a digital image that has only two possible values for each pixel. Typically the two colors used for a binary image are black and white though any two colors can be used.

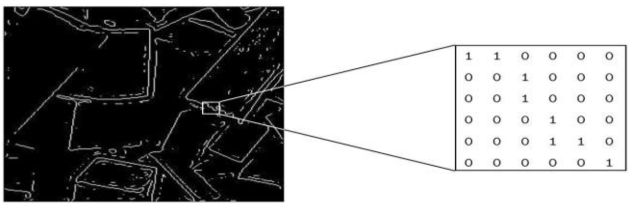

Figure.1. Binary Image Representation

Gray scale Image

(Grayscale Images) In photography and figuring, a grayscale or greyscale advanced Image is such type of image in which the estimation of every pixel is a solitary specimen, that is, it conveys just force data.

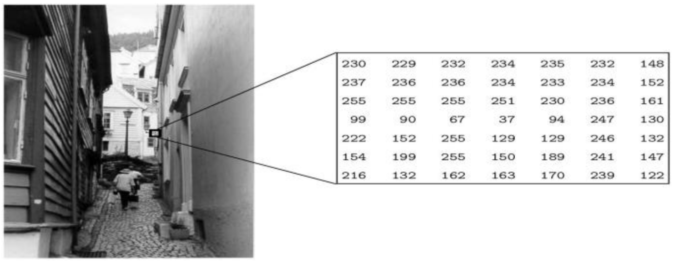

Figure .2. Gray Image Representation

1.3 Color Image

A shading Image is a computerized Image that incorporates shading data for every pixel. For outwardly worthy outcomes, it is important to give three specimens to every pixel, which are translated as directions in some shading space.

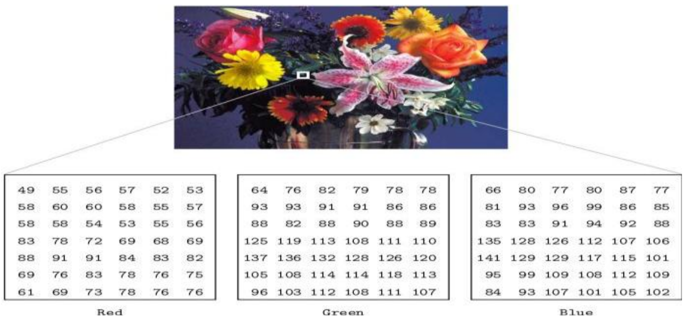

Figure.3. Color Image Representation

This work is identified with the field of Image handling, uncommonly scaling or zooming. As each Image get bended, when scaling operation is connected proceed after some farthest point. This contortion is represented the loss of data between two pixels, which are isolated on scaling.

There are two type of Image Scaling Techniques

I. Traditional Image Scaling
II. Interpolation Image Scaling

2. TRADITIONAL IMAGE ZOOMING

Traditional image zooming techniques use up-sampling by zero-insertion followed by one-dimensional filtering to interpolate the HR samples. The main drawback of this approach is that the frequency content of the high-resolution image is the same as the Low-Resolution (LR) image. This is due to the fact that linear techniques are incapable of introducing new information into the image. The lack of new high frequency content results in a variety of undesirable image artifacts such as blocking, staircase edges and blurring

An image get distorted after certain size

Distortion is a deviation from rectilinear projection, a projection in which straight lines in a scene remain straight in an image. It is a form of optical aberration.

2.1 Blurring

Blurring is related to aliasing in the sense that it is also a mismatch between an intermediate data representation and their final down sampled or over sampled version. In this case, the mismatch is such that the intermediate data is too coarse for the task. This results in an image that appears to be out of focus. To highlight blurring, it is enough to iterate the same interpolation operation several times, thus effectively magnifying the effect.

2.2 Blocking

Blocking arises when the support of the interpolate is finite. In this case the influence of any given pixel is limited to its surroundings, and it is sometimes possible to discern the boundary of this influence zone. Synthesis functions with sharp transitions, such as those in use with the method named nearest neighbor interpolation

2.3 Jaggies

Jaggies are stair like lines that appear where there should be smooth straight lines or curves. For example, when a nominally straight, un-aliased line steps across one pixel, a dogleg occurs halfway through the line, where it crosses the threshold from one pixel to the other.

Original Jaggies Blurring Blocking

Figure.4. Zebra Image

3. INTERPOLATION IMAGE ZOOMING

Interpolation is the process by which a small image is made larger. Software tools stretch the size of the image and generate pixels to fill in the blanks. Interpolation is the estimation of values in a function between known points. Interpolated images produce smoother lines and a better large print than if the original, small image was simply printed large. There are several basic function-fitting or interpolation methods, including pixel replication, nearest neighbor interpolation, bilinear interpolation, and bicubic interpolation, b-spline interpolation

There are basically four Interpolation which used for analysis purpose

1. Nearest Neighbor Interpolation
2. Bilinear Interpolation
3. Bi-cubic Interpolation
4. B-spline Interpolation

3.1 Nearest Neighbor Interpolation

Nearest Neighbor Interpolation, the simplest method, determines the grey level value from the closest pixel to the specified input coordinates, and assigns that value to the output coordinates. It should be noted that this method does not really interpolate values, it just copies existing values. Since it does not alter values, it is preferred if subtle variations in the grey level values need to be retained. For one-dimension Nearest Neighbor Interpolation, the number of grid points needed to evaluate the interpolation function is two. For two-dimension Nearest Neighbor Interpolation, the number of grid points needed to evaluate the interpolation function is four. The nearest neighbor, where each interpolated output pixel is assigned the value of the nearest sample point in the input image. This technique is also known as point shift algorithm and pixel replication.

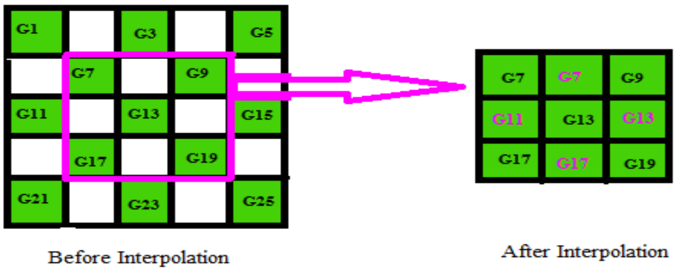

Figure.5. Nearest Neighbor Interpolation Working

3.2 Bilinear Interpolation

In mathematics, bilinear interpolation is an extension of linear interpolation for interpolating functions of two variables on a regular grid. The interpolated function should not use the term of x_2 and y_2 but xy, which is the bilinear form of x and y

Bilinear interpolation considers the closest 2×2 neighborhood of known pixel values surrounding the unknown pixel. It then takes a weighted average of these 4 pixels to arrive at its final interpolated value.

If we are estimating a pixel between a block of four original values, then two temporary values are first created: a linear interpolation between the top pair of pixels; and the second, a linear interpolation between the bottom pair of pixels. Lastly, a linear interpolation is performed between the two temporary values.

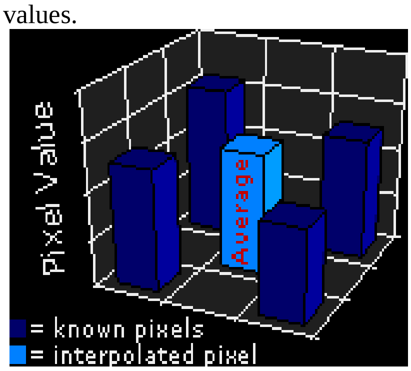

Figure.6. Bilinear Interpolation

Weight is determined by assigning weighted value of 4-nearest neighbor pixel (as shown in Figure) to generated output pixel. Each weighing value is proportional to distance from each existing pixel. This method has advantage of simple calculation. However, blurring effect is occurred by averaging surround pixel.

3.3 Bi-cubic Interpolation

Bi-cubic interpolation is an extension of cubic interpolation for interpolating data points on a two dimensional regular grid. The interpolated surface is smoother than corresponding surfaces obtained by bilinear interpolation or nearest neighbor interpolation.

Bi-cubic interpolation uses the information from an original pixel and sixteen of the surrounding pixels to determine the color of the new pixels that are created from the original pixel. Bi-cubic interpolation is a big improvement over the previous two interpolation methods for two reasons:

(1) Bi-cubic interpolation uses data from a larger number of pixels

(2)Bi-cubic interpolation uses a bi-cubic calculation that is more sophisticated than the calculations of the previous interpolation methods as shown in Figure. Bi-cubic interpolation is capable of producing photo quality results and is probably the method most commonly used.

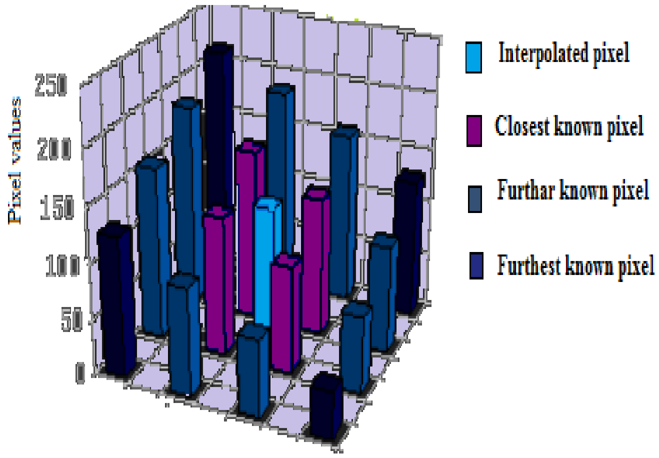

Figure.7. Bi-cubic Interpolation

This is a high performance pixel interpolation that gives outstanding results, both in calculation speed and in quality of results. It is usually the best choice when not too radical down sampling operations are involved in geometrical transformations. This form of interpolation has advantages and drawbacks over bilinear interpolation. First, calculating the cubic polynomial in a specific area of the image is more computationally expensive than simple linear fits and also requires a larger neighbor to calculate the curve. A linear function fits straight lines between known points, and a cubic function fits cubic splines. On the other hand, jaggies are more distinguished since the image isn't as blurred.

3.4 B-Spline

In the mathematical subfield of numerical analysis, a B-spline, or Basis spline, is a spline function that has minimal support with respect to a given degree, smoothness, and domain partition. Any spline function of given degree can be expressed as a linear combination of B-splines of that degree. Cardinal B-splines have knots that are equidistant from each other. B-splines can be used for curve-fitting and numerical differentiation of experimental data.A B-spline is a piecewise polynomial function of degree k in a variable x. It is defined over a range $t\ 0 \leq x \leq t_m$, t_m - t 0 = k+1. The points where x = t_{jj} are known as knots or break-points. The number of internal knots is equal to the degree of the polynomial. The knots must be in ascending order. The number of knots is the minimum for the degree of the B-spline, which has a non-zero value only in the range between the first and last knot. Each piece of the function is a polynomial of degree k between and including adjacent knots. A B-spline is a continuous function at the knots. When all internal knots are distinct its derivatives are also continuous up to the derivative of degree k-1. If internal knots are coincident at a given value of x, the continuity of derivative order is reduced by 1 for each additional knot. For any given set of knots, the B-spline is unique, hence the name, B being short for Basis. The usefulness of B-splines lies in the fact that any spline function of degree k on a given set of knots can be expressed as a linear combination of B-splines.

4. Experimental Setup

Enlarging a picture (up sampling or interpolating) is usually common for creating smaller imaging match a much bigger screen fully screen mode. during this numerous interpolation techniques square measure applied to totally different domain of pictures, and their effectiveness is ascertained mistreatment totally different parameter like image, intensity and edges. However, there square measure many ways of skyrocketing the quantity of pixels that a picture contains, that evens out the looks of the initial pixels.

4.1 Images for Scaling

An image is a visual representation of something. In information technology, the term has several usages:

An image is a picture that has been created or copied and stored in electronic form. An image can be described in terms of vector graphics or raster graphics. An image stored in raster form is sometimes called a bitmap. An image map is a file containing information that associates different locations on a specified image with hypertext links.

4.2 Human Face Image:

The face is a central organ of sense and is also very central in the expression of emotion among humans and among numerous other species.

Figure 8.

Figure 9.

4.3 Result Parameter

Result parameter is a characteristic, feature, or measurable factor that can help in defining a particular system. A parameter is an important element to consider in evaluation or comprehension of an event, project, or situation. Parameter has more specific interpretations in mathematics, logic, linguistics, environmental science, and other disciplines.

4.3.1 Visual Properties of Interpolated Images

The first 8 are visual properties of the interpolated image the last is a computational property of the interpolation method:

i. **Geometric Invariance:** The subject matter should not change by using interpolation methods in order to preserve the geometry and relative sizes.

ii. **Contrast Invariance:** The method should preserve the overall luminance values of in an image and contrast of the image.

iii. **Noise:** The method should not add noise or other artifacts to the image.

iv. **Edge Preservation:** The method should preserve edges and boundaries and sharpen them where possible.

v. **Aliasing:** The method should not produce staircase edges.

vi. **Texture Preservation:** The method should not blur or smooth textured regions.

vii. **Over-smoothing:** The method should not produce undesirable piecewise constant or blocky regions.

viii. **Application Awareness:** The method should produce appropriate results to the type of image and order of resolution.

ix. **Sensitivity Parameters:** The method should not be too sensitive to internal parameters that may vary from image to image.

4.3.2 Image intensity

This term refers to the brightness of a point in an image. The intensity of a pixel is determined by several quantities including the local value of a RGB, The amount of light reflected by a surface element depends on its micro-structure and the distribution of incident light.

4.3.3 Edge

i. Edges are significant local changes of intensity in an image.
ii. Edges typically occur on the boundary between two different regions in an image.
iii. An edge can be defined as a set of contiguous pixel positions where an abrupt change of intensity (gray or color) values occur.

An edge in an image is a boundary or contour at which a significant change occurs in some physical aspect of an image, such as the surface reflectance, illumination or the distances of the visible surfaces from the viewer. Changes in physical aspects manifest themselves in a variety of ways, including changes in intensity, color, and texture.

Detecting edges is very useful in a no of contexts. For example in a typical image understanding task such as object identification, an essential step is to segment an image into different regions corresponded to different objects in the scene. Edge detection is the 1st step in image segmentation.

4.4 Experimental Result

Table 1.

Interpolation Techniques	Value
Nearest Neighbor Interpolation	3
Bi-cubic Interpolation	3.5
Bi-Linear Interpolation	3.8
B-Spline Interpolation	5.1

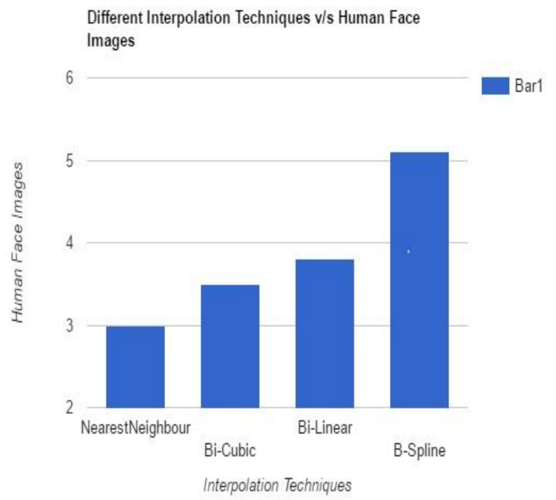

Figure 10

5. CONCLUSION

In the Interpolation techniques artifacts such as blurring, jaggies and blocking in images are less than the other available traditional zooming methods. Try to minimize the artifacts that are ruling in standard magnification techniques. Basically, the Interpolation techn- iques concentrates on edges present in the image and works on minimizing the artifacts. This leads to the conclusion that different interpolation techniques provides better results both visually and quantitatively on different types of images. By applying Nearest Neighbor, Bi-Linear, Bi-Cubic, B-Spline interpolation techniques on the Human Face images following conclusion are carried out.

1. Nearest Neighbor Interpolation is better for those domain of images whose contain same number of pixel in large area of image have maximum scaling value like real object. But rest of domain whose need smooth edges and less artifacts, this interpolation is not good enough for those domain of images.

2. Bi-Cubic interpolation performed good on that domain of images which not follow same pattern on their architecture and contain curve.

3. Bi-Linear interpolation is better for those domain in which some blurriness is allowed have maximum scaling value.

4. B-spline interpolation work properly comparative to other interpolation on almost all domains of images, because it

finds more accurate intermediate value using known pixel value.

This leads to be concluded that different interpolation techniques provides better results both visually and quantitatively on Human Face of images.

6.FUTURE WORK

The future work would involve the improvement of the interpolation techniques for the images and also improve its processing speed. Although image interpolation is widely used in image processing, each application has its specific requirements. Thus, depending on the application, an appropriate choice of evaluation methods should be made. Furthermore, whether an evaluation method is optimal or not is associated with the interpolation technique, the content of the image and the geometric transform.

The proposed evaluation categorization makes a discrete separation between performance and cost requirements. For applications such as medical imaging, where the most crucial feature is the fidelity of the output image, the most appropriate methods are included in the performance category. More specifically, since the contents are low-frequency images the interpolation quality criteria should be used, since it can give an overall measure of quality. For applications which include high-frequency images, such as text or document processing, Fourier analysis or the step-edge response metrics should be preferred.

However, sophisticated interpolation algorithms which cannot be expressed by a single basis function such as neural network or fuzzy approaches can be evaluated only using the step-edge response method. In contrast to quality performance demanding applications, the cost analysis is appropriate to applications with limited resources. Depending on the critical resource of the application, the equivalent evaluation method should be applied. If there are real-time constraints, the design and evaluation strategy should be based upon minimizing the runtime factor. Before establishing an interpolation algorithm in a mobile embedded device, power requirement analysis must be performed since in this application the most critical factor is power consumption which is equal to increased memory standby time. Data memory and computational burden analysis is vital in applications that interpolate large spatial resolution images.

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