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IMAGE PROCESSING
01CE0507

Unit – 1
Introduction to Digital Image Processing

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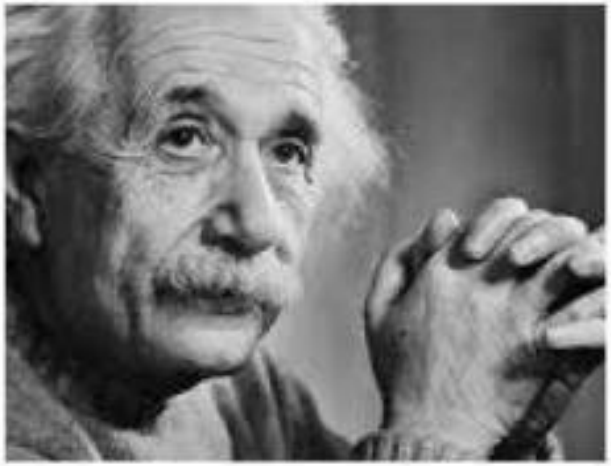
Outline

- Concept Of Zooming
- Steps Of Zooming
- Types of Zooming
- Methods of Zooming
  - Pixel replication or /Nearest neighbor interpolation
  - Zero order hold method
  - Zooming K times

Zooming

- Zooming simply means enlarging a picture in a sense that the details in the image became more visible and clear.
- Zooming an image has many wide applications ranging from zooming through a camera lens, to zoom an image on internet etc.

Zooming (Cont.)



Steps Of Zooming

- You can zoom something at two different steps.
  - The first step includes zooming before taking an particular image. This is known as pre processing zoom. This zoom involves hardware and mechanical movement.
  - The second step is to zoom once an image has been captured. It is done through many different algorithms in which we manipulate pixels to zoom in the required portion.

Types of Zooming

- 2 Types of Zooming
  - Optical Zoom
  - Digital Zoom

Optical Zoom

- The optical zoom is achieved using the movement of the lens of your camera.
- An optical zoom is actually a true zoom.
- The result of the optical zoom is far better then that of digital zoom.
- In optical zoom, an image is magnified by the lens in such a way that the objects in the image appear to be closer to the camera.
- In optical zoom the lens is physically extend to zoom or magnify an object.

Digital Zoom

- Digital zoom is basically image processing within a camera.
- During a digital zoom, the center of the image is magnified and the edges of the picture got crop out.
- Due to magnified center, it looks like that the object is closer to you.
- During a digital zoom, the pixels got expand , due to which the quality of the image is compromised.
- The same effect of digital zoom can be seen after the image is taken through your computer by using an image processing toolbox / software, such as Photoshop.

Optical Zoom vs Digital Zoom

Optical Zoom	Digital Zoom
Optical zoom is used by Photographer to capture an image without moving physically closer to that object.	Digital zoom is a part of digital cameras. It can crop the entire image, and the portion of an image which is zoomed can be digitally enlarged.
In a digital camera, the optical zoom ratio is used to measure lens, that how much it can be zoomed to make the object appear closer. Optical zoom enlarges an image, and it keeps the resolution and sharpness of the image high.	Digital zoom crops the image from the center with the same ratio from all the sides. And the image results in the original dimension of the pixel. As this method involves cropping, so the image quality and resolution are reduced.
There is no relation between the optical zoom and the resolution of an image. Because the optical zoom is used to enlarge the image and its quality depends on the megapixel of the camera.	As the digital camera can crop a portion of an image and enlarge it to its original size. Due to this, the quality of the image is reduced as compared to the original image.
Optical zoom is useful when an image is taken in landscape or if we want a closer view of an object without reducing the quality of the image. For example, taking a picture of the rainbow in the sky.	Digital zoom is used to take images from closer to the object when the photographer wants to take pictures of a particular object For example, clicking pictures at the birthday party of the birthday boy.

Zooming Methods

- Methods of Zooming are
  - Pixel replication or (Nearest neighbor interpolation)
  - Zero order hold method
  - Zooming K times

Pixel Replication / (Nearest Neighbor Interpolation)

- Pixel replication is also known as Nearest neighbor interpolation.
- In this method, a copy is produced of the neighboring pixels.

Pixel Replication / Nearest Neighbor Interpolation (Cont.)

- Working:
  - In this method we create new pixels form the already given pixels.
  - Each pixel is replicated in this method n times row wise and column wise and you got a zoomed image.

Pixel Replication / Nearest Neighbor Interpolation (Cont.)

- if you have an image of 2 rows and 2 columns and you want to zoom it twice or 2 times using pixel replication, here how it can be done.
- For a better understanding, the image has been taken in the form of matrix with the pixel values of the image.

1	2
3	4

Pixel Replication / Nearest Neighbor Interpolation (Cont.)

Step 1: Row wise zooming:

- When we zoom it row wise, we will just simple copy the rows pixels to its adjacent new cell.

1	1	2	2
3	3	4	4

Pixel Replication / Nearest Neighbor Interpolation (Cont.)

Step 2: Column size zooming:

- The next step is to replicate each of the pixel column wise, that we will simply copy the column pixel to its adjacent new column or simply below it.

1	1	2	2
1	1	2	2
3	3	4	4
3	3	4	4

Pixel Replication / Nearest Neighbor Interpolation (Cont.)

- New image size:
  - As it can be seen from the above example, that an original image of 2 rows and 2 columns has been converted into 4 rows and 4 columns after zooming.
- That means the new image has a dimensions of

(Original image rows * zooming factor, Original Image cols * zooming factor)

Pixel Replication / Nearest Neighbor Interpolation (Cont.)

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- Advantage and disadvantage:
  - One of the advantage of this zooming technique is, it is very simple. You just have to copy the pixels and nothing else.
  - The disadvantage of this technique is that image got zoomed but the output is very blurry. And as the zooming factor increased, the image got more and more blurred. That would eventually result in fully blurred image.

Pixel Replication / Nearest Neighbor Interpolation (Cont.)

- Apply Pixel Replication / Nearest neighbour interpolation method to perform the zooming of the below image. (Consider Zooming Factor = 3)

1	2	3
4	5	6

Zero Order Hold Method

- Zero order hold method is another method of zooming.
- It is also known as zoom twice. Because it can only zoom twice.

Zero Order Hold Method (Cont.)

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- Working
  - In zero order hold method, we pick two adjacent elements from the rows respectively and then we add them and divide the result by two, and place their result in between those two elements.
  - We first do this row wise and then we do this column wise.

Zero Order Hold Method (Cont.)

- Lets take an image of the dimensions of 2 rows and 2 columns and zoom it twice using zero order hold.

1	2
3	4

Zero Order Hold Method (Cont.)

- Step 1: Row wise zooming
  - As we take the first two numbers : (2 + 1) = 3 and then we divide it by 2, we get 1.5 which is approximated to 2. The same method is applied in the row 2.

1	2
3	4

1	2	2
3	4	4

Zero Order Hold Method (Cont.)

- Step 2: Column wise zooming
  - We take two adjacent column pixel values which are 1 and 3. We add them and got 4. 4 is then divided by 2 and we get 2 which is placed in between them.
  - The same method is applied in all the columns.

1	2	2
3	4	4

1	2	2
2	3	3
3	4	4

Zero Order Hold Method (Cont.)

- New image size
  - As you can see that the dimensions of the new image are 3 x 3 where the original image dimensions are 2 x 2. So it means that the dimensions of the new image are based on the following formula

    (2*no of rows-1) X (2*no of columns-1)

Zero Order Hold Method (Cont.)

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Advantages and disadvantage.

- One of the advantage of this zooming technique , that it does not create as blurry picture as compare to the nearest neighbor interpolation method.
- But it also has a disadvantage that it can only run on the power of 2.

Zero Order Hold Method (Cont.)

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- Apply Zero Order Hold Method to perform the zooming of the below image. (Consider Zooming Factor = 2)

1	2	3
4	5	6

K-Times Zooming Method

- K times is the third zooming method we are going to discuss.
- It is one of the most perfect zooming algorithm discussed so far.
- It caters the challenges of both twice zooming and pixel replication.
- K in this zooming algorithm stands for zooming factor.

K-Times Zooming Method (Cont.)

- Working:
  - It works like this way.
  - First of all, you have to take two adjacent pixels as you did in the zooming twice. Then you have to subtract the smaller from the greater one. We call this output (OP).
  - Divide the output(OP) with the zooming factor(K). Now you have to add the result to the smaller value and put the result in between those two values.
  - Add the value OP again to the value you just put and place it again next to the previous putted value. You have to do it till you place k-1 values in it.
  - Repeat the same step for all the rows and the columns, and you get a zoomed images.

K-Times Zooming Method (Cont.)

- Suppose you have an image of 2 rows and 3 columns, which is given below. And you have to zoom it thrice or three times.

15	30	15
30	15	30

- K in this case is 3. K = 3.
- The number of values that should be inserted is k-1 = 3-1 = 2.

K-Times Zooming Method (Cont.)

- Step 1: Row wise zooming
  - Take the first two adjacent pixels. Which are 15 and 30.
  - Subtract 15 from 30. 30-15 = 15.
  - Divide 15 by k. 15/k = 15/3 = 5. We call it OP.(where op is just a name)
  - Add OP to lower number. 15 + OP = 15 + 5 = 20.
  - Add OP to 20 again. 20 + OP = 20 + 5 = 25.
  - We do that 2 times because we have to insert k-1 values.
  - Now repeat this step for the next two adjacent pixels. It is shown in the first table.
  - After inserting the values, you have to sort the inserted values in ascending order, so there remains a symmetry between them.

K-Times Zooming Method (Cont.)

- Step 1: Row wise zooming

Table 1:

15	30	15
30	15	30

15	20	25	30	20	25	15
30	20	25	15	20	25	30

Table 2:

15	20	25	30	25	20	15
30	25	20	15	20	25	30

K-Times Zooming Method (Cont.)

- Step 2: Column wise zooming
  - The same procedure has to be performed column wise.
  - The procedure include taking the two adjacent pixel values, and then subtracting the smaller from the bigger one.
  - Then after that, you have to divide it by k. Store the result as OP. Add OP to smaller one, and then again add OP to the value that comes in first addition of OP.
  - Insert the new values.

K-Times Zooming Method (Cont.)

- Step 2: Column wise zooming

Table 3:

5	20	25	30	25	20	15
20	21	21	25	21	21	20
25	22	22	20	22	22	25
30	25	20	15	20	25	30

K-Times Zooming Method (Cont.)

- New image size
  - The best way to calculate the formula for the dimensions of a new image is to compare the dimensions of the original image and the final image. The dimensions of the original image were 2 X 3. And the dimensions of the new image are 4 x 7.
- The formula thus is:

(K (no. of rows - 1) + 1) X (K (no. of cols - 1) + 1)

K-Times Zooming Method (Cont.)

- Advantages and disadvantages
  - The one of the clear advantage that k time zooming algorithm has that it is able to compute zoom of any factor which was the power of pixel replication algorithm , also it gives improved result (less blurry) which was the power of zero order hold method. So hence It comprises the power of the two algorithms.
  - The only difficulty this algorithm has that it has to be sort in the end, which is an additional step, and thus increases the cost of computation.

K-Times Zooming Method (Cont.)

Apply K-Times Zooming method on 2 rows and 3 columns of an image. And we want to zoom in the image thrice.

2	3	4
5	6	7


Thank
you