Digital Image Processing
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Module 11 Lecture Number 54
Pseudo Colour Image Processing

Hello, welcome to the video lecture series on Digital Image Processing.

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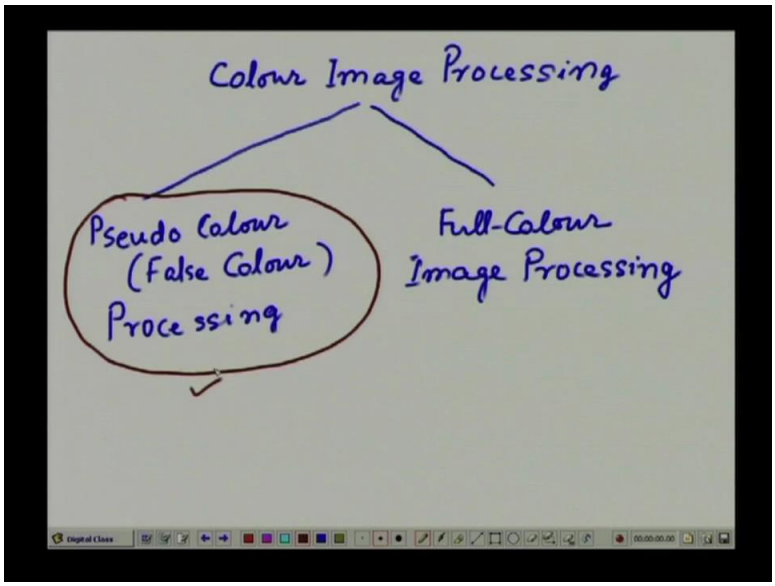

That when we talk about colour image processing techniques. Generally, we have two categories of colour image processing, one is called Pseudo colour image processing or this is also known as False colour. So Pseudo colour processing and the other category is that is known as Full color processing. So we have just said that this Pseudo colour processing, the basic purpose of Pseudo colour processing technique is to assign different colours in different, for different Intensity ranges in a black and white image.

The purpose is as we have told earlier that given a black and white image or human eye can simply distinguish between only around two dozens of black and white shades or Intensity shades. Whereas given a colour given a colour image, we can distinguish among thousands of colour shades. So given a black and white image or an intensity image if we go for Pseudo colour processing techniques that is assign different colours to different ranges of Intensity

values, in that case interpretation of such an Intensity image is more convenient than the interpretation of an ordinary or simple Intensity level image.

Now the basic way which Pseudo colouring can be used that is as we said that the purpose of Pseudo colouring technique is to assign different colours to different ranges of Intensity values the simplest approach in which the Pseudo colouring can be done is by making use of Intensity slices. So what we can do is we can consider an Intensity image to be a 3 D surface.

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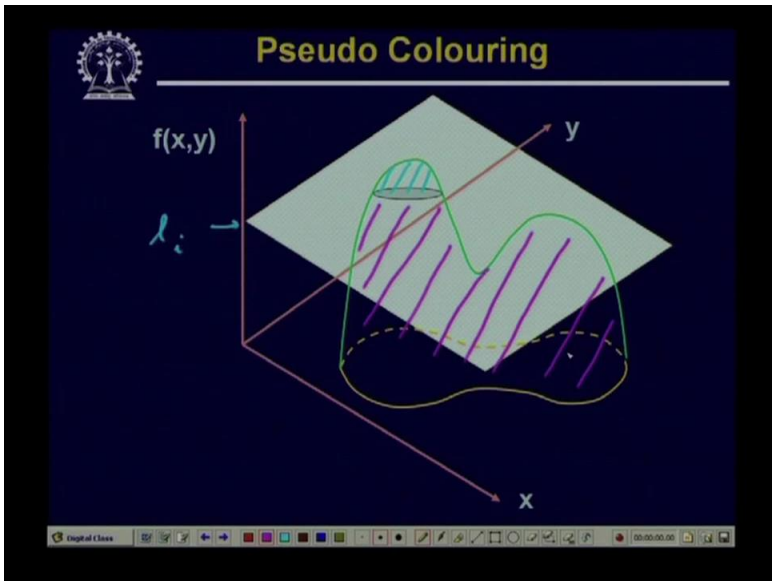

So as shown in this particular slide that given an Intensity image say F (X, Y) which is a function of X and Y. So different Intensity values at different locations of X and Y, if we consider them to be a 3 dimensional surface then what we can do is we can place planes which are parallel to the image plane that is parallel to the X- Y plane. So as shown in this particular diagram if place such a plane at some Intensity value say X I, so at this Intensity value, say l I we have placed a plane which is parallel to X- Y plane.

Now we find that this particular plane which is parallel to X-Y plane this slices the Intensities into different two different hubs. So once I get this two different hubs what I can do is, I can assign a different colour to two different two different sides of this particular plane. So on this side, I can assign one particular colour, whereas on the other side that is this side, I can assign

another colour. So this is the basic technique of Pseudo colouring that is you slice the intensity levels and to different slices you assign different colours.

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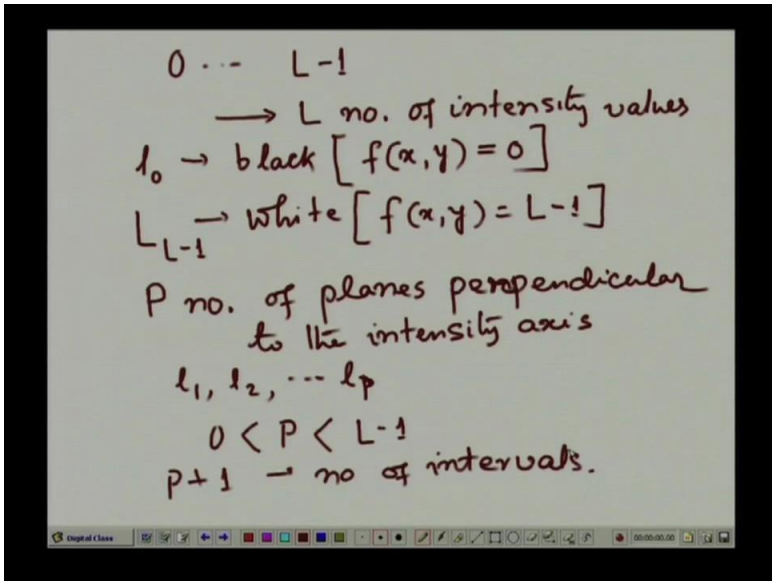

So in our case, we assume let us assume that our in image the intensity values the discrete Intensity values in a black and white image varies from say 0 to L – 1. So I have total L number of Intensity values in our image, L number of Intensity values. So one we have this L number of Intensity values and we assume that an Intensity value says L 0 which represents an Intensity level say black, this means that the corresponding F (x,y) at (lec) location X Y where the Intensity that is l 0 this is equal to zero.

Similarly, the L minus first in that level I assume that this is equal to white that means all the corresponding pixels F (x,y) will have a value equal to L minus 1, and let us also assume that we have will draw P number of planes, number of planes perpendicular to the Intensity axis. So perpendicular to Intensity axis means they are parallel to the image plane and these planes will be placed at the Intensity values given by say l 1, l 2 up to say… l p.

So the first plane will be placed at Intensity values l 1, the second plane will be placed at Intensity l 2 and this way the P F plane will be placed at Intensity values value l p. So obviously, in this case P the number of planes has to live from 0 to L minus 1, where L is the number of grey level intensities that we have. So, once we place such P number of planes, which are

perpendicular to the Intensity axis these P number of planes divide the intensities into P plus 1 number of intervals.

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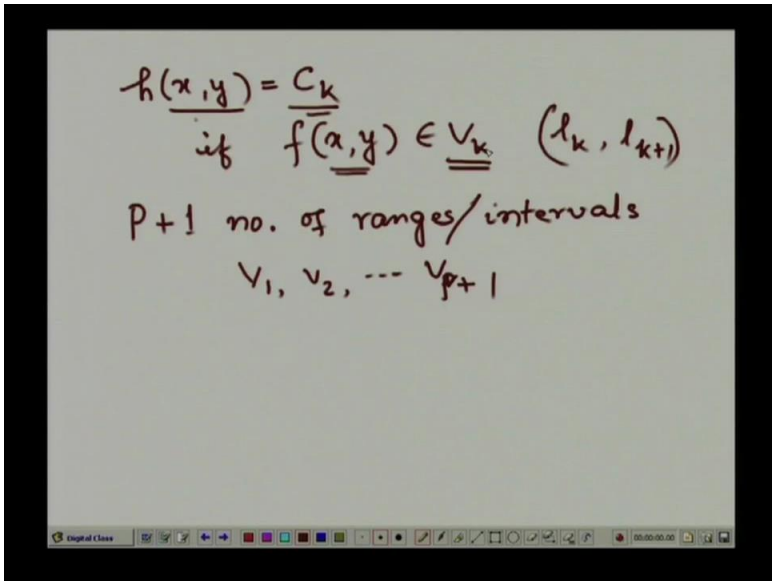

So once I divide, the Intensity ranges into P plus 1 number of intervals then our colour assign approach will be that a particular location, the colour to location F(x,y) this colour will be equal to C k or instead of calling it F, let me call it some function say h. So the colour assigned to location X-Y which is h (X, Y) will be C k, if the corresponding Intensity value at that location X Y F (x,y) lies in the range V k, where V k is the Intensity range which is defined by the planes placed at location l k and l k plus 1.

So as we said that there are P number of planes, so these P number of planes will divide our Intensity range into P plus 1 number of ranges or intervals and we call this interval as interval V 1, V 2,… up to interval V p plus 1. So we assign colour C k to a particular location X Y so we write h (x,y) will be equal to C k, if the Intensity value at the corresponding location which is given by F (x,y) this Intensity values belongs to the interval V k.

Now by using this simple concept that is you divide your Intensity range into a number of intervals and to a particular location in the Intensity image you assign a colour which is determined by in which of intervals the Intensity of the image at that particular location belong then what we get is a Pseudo coloured image.

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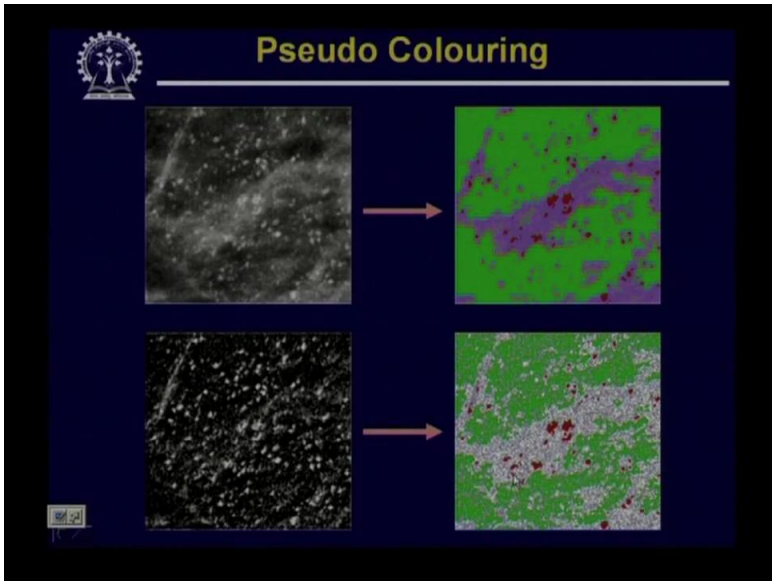

So let us see some example of this Pseudo coloured image here we have say said that on the left-hand side we have an Intensity image of black and white image. If I apply Pseudo colouring if I go for Pseudo colouring techniques then the Pseudo coloured image is as shown on the right-hand side. Similarly the bottom one this is an image which is an enhanced version of this and if I apply Pseudo colouring technique to this particular black and white image then the corresponding Pseudo coloured image is given on the right-hand side.

So here you find that interpretation in the Pseudo coloured image of the distinction between Intensity levels in the Pseudo coloured image is much more easier than the distinction in corresponding Intensity image or the grey scale image.

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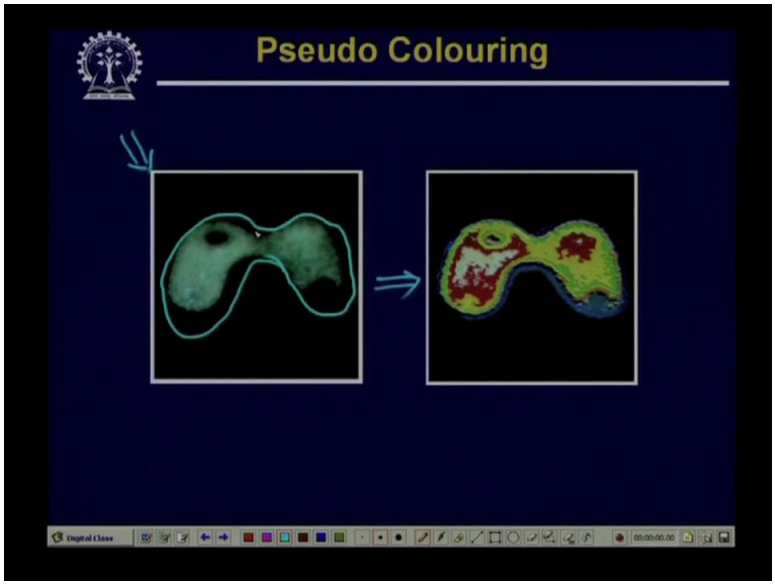

Now this particular application will be more prominent in this particular diagram. Here again you find that on the left-hand side we have an Intensity image or grayscale image and you find that in this regions the Intensity values appears to be more or less flat that means I cannot distinguish between different Intensity levels, which are present in this particular diagram.

Whereas on the right-hand side if I go for Pseudo colouring you find that this different colours which are assigned to different Intensity levels in this particular black and white image. This clearly tells us what are the different colour regions of different Intensity values in this particular black and white image. So another application the other application of Pseudo colouring technique is from grey to colour transformation.

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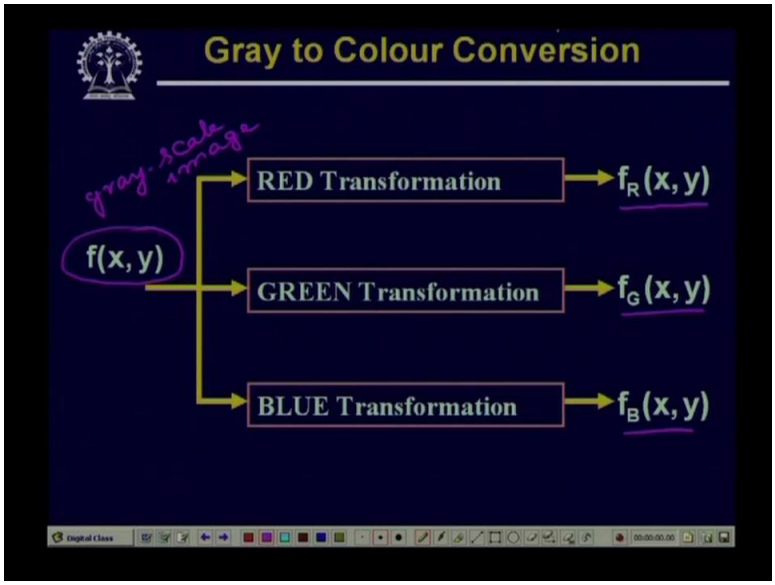

So here what we have shown is to different Intensity intervals we have assigned different colours. Now when we go for grayscale to colour transformation then what we have to do is, if I have an Intensity image or grayscale image that corresponds to a single plane, I have to convert that to three different planes that is R G B red, green and blue planes and those red, green and blue planes when they combine together there combine together they give you an interpretation of a colour image.

So that kind of colour grey to colour transformation can be done by using this type of transformation function. So here you find that our input image F (x, y) this is a Intensity image or grayscale image. Then what we are doing is this grayscale image transformed by three different transformations, one corresponds to the red transformation, the other corresponds to the green transformations and the third one corresponds to the blue transformation.

This red transformation generates the red plane of this image which is given by F R (x,y) the green transformation generates the F G (x,y) or the green plane corresponding to this Intensity image F (x,y) and the blue transformation generates F B (x,y), which is the blue plane corresponding to this Intensity image F (x,y). So when this three images that is F R F (x,y) F R (x,y) F G (x,y) and F B (x,y) the red, green and blue planes, they are combined together and displayed on a colour display what we get is a Pseudo coloured image.

But in this case you find that the colour is not assigned to different Intensity ranges but that colour is decided the colour of the inter-image is decided by the corresponding transformation functions. So the colour contain of the colour image that we will generate that is determined by the transformation functions that we use. Now let us see that what are the kind of colour images that we can obtain using this grayscale to colour transformation.

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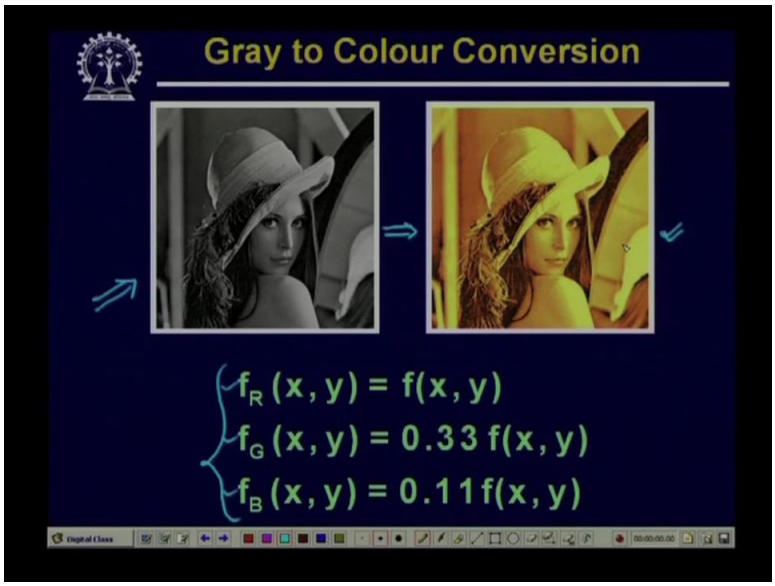

So in this diagram, as it is shown on the left-hand side we have an Intensity image or a black and white image, which is transformed into a colour image. So on the right hand side is the corresponding color image and the colour transformations that has been used are like this here we have used that F R (x,y) is equal to F (x,y) that means whatever is the black and white Intensity image that is simply copied to the red plane. The green plane the F G (x,y) is generated by 0.33 F (x,y) that means the Intensity values at any location in the original black and white image is divided by three and whatever value we get that is copied to the corresponding location in the green plane.

Similarly, F B(x,y) the blue plane is generated by the by dividing the Intensity image by by multiplying the Intensity image by a value 0.11 or dividing the Intensity image by a value 9. So by this transformation functions, we have generated F R the red component, F G the green component and F B the blue component and when we combine this red component a green component and blue component the corresponding colour image which is generated is like this.

Now, here you should remember one point that this colour image that is being generated it is Pseudo coloured image. Obviously, it is not a full-color image or the colour of the original image is not generated in this manner. So the only purpose is the different Intensity the different Intensity regions will appear as different colours in our coloured image. So this colouring is again a Pseudo colouring it is not the real colouring.

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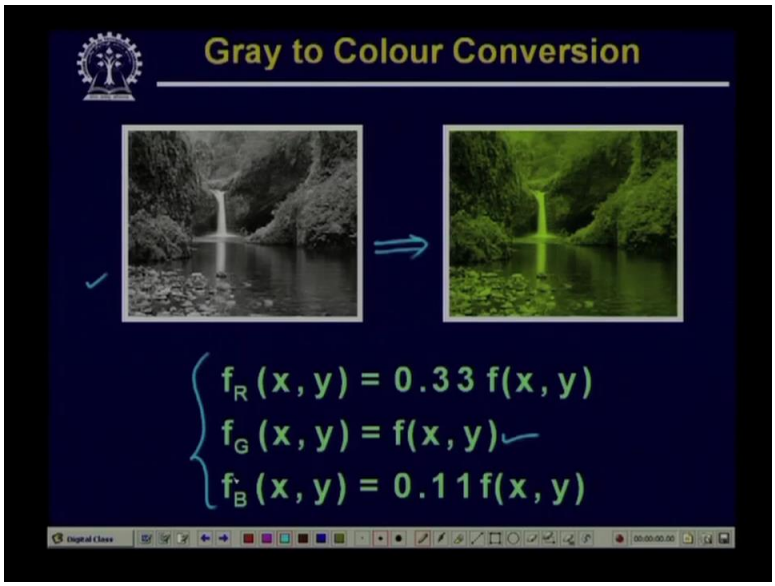

Now we have another example on the Pseudo colouring, here it is a natural seen where again on the left-hand side we have the Intensity image or the black and white image and when we go for grey scaling to colour transformation, now the transformation are like this is here the green component is same as the original Intensity image. So we have taking F G (x,y) is equal to F (x,y), where F (x,y) is the original Intensity image.

The red component is generated as one-third of (x,y) and the blue component is generated as one-ninth of (x,y). So by generating the red, green and blue components blue planes from the original F (x,y) in this manner and if you combine them the corresponding Pseudo coloured image that we get is given on the right-hand side. So, here you find that if I compare the earlier image with this.

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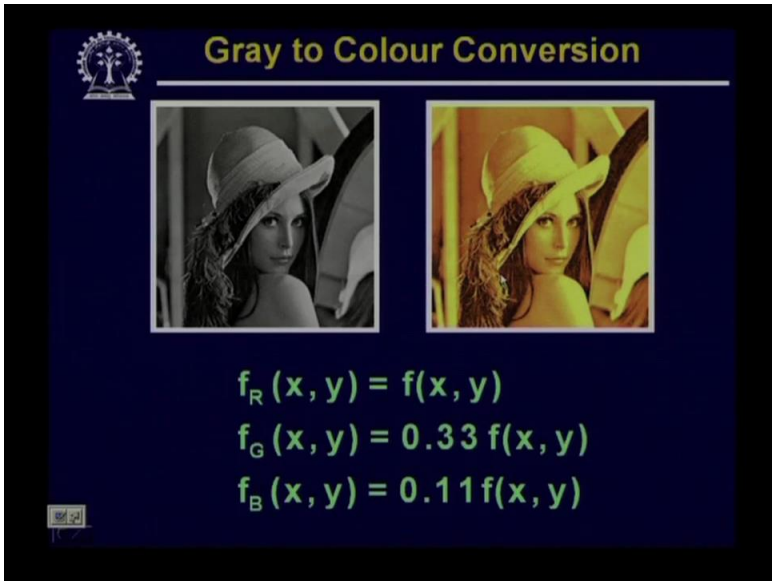

In our earlier case, the coloured image was showing more of red component because in this case, F R was as seen as F (x,y) whereas green and blue where scale down version of F (x,y).

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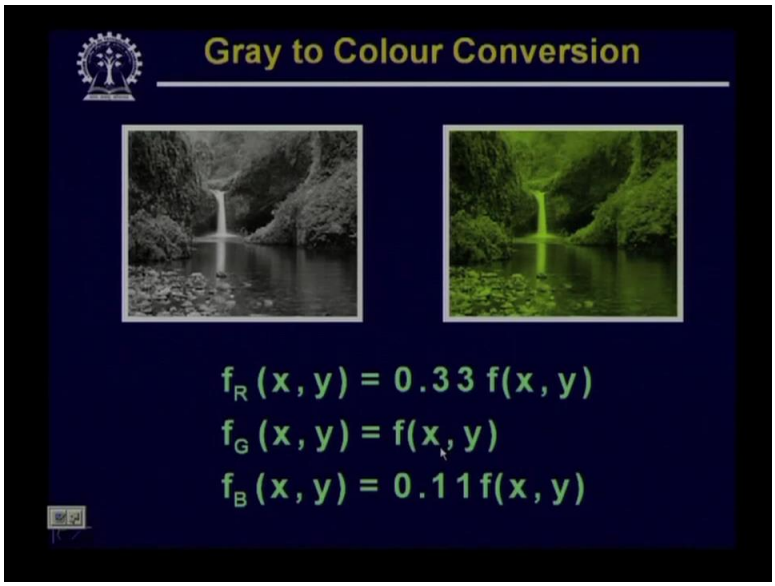

Whereas in this particular case our Pseudo coloured image appears to be green because here F (x,y) F the green component, the green plane is same as F (x,y) whereas red and blue are taken as scaled down version of F (x,y). So if we change the weightage of this a different function of this different red and blue green, red and blue planes. The colour appearance will again be different.

So a grey scale image can be converted to a Pseudo colouring image by this kind of conversion by applying different transformations for different red, green and blue plane.

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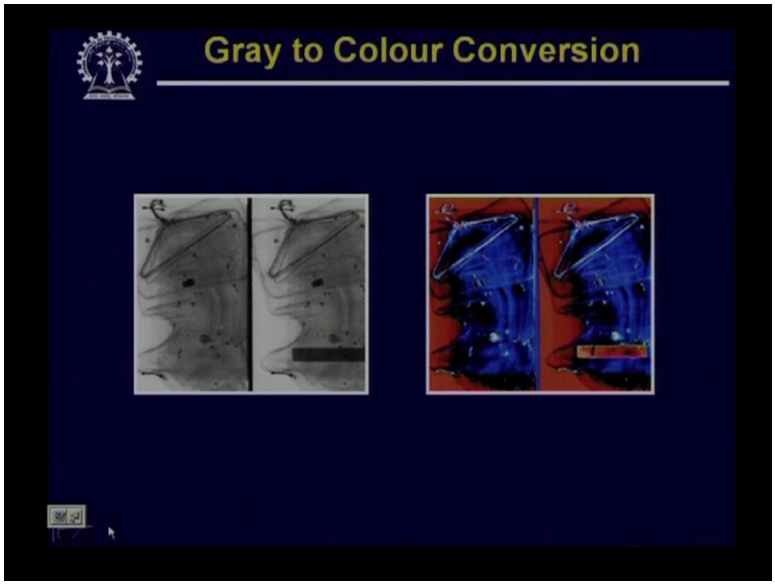

Now many of you might have seen the (())(19:35) security machine like what is used in a airports. Here you find that this is an x-rayimage on the left-hand side of a baggage, which is screened by a (())(19:50) machine. If you have looked at the screen which the security people checks, on the screen this image appears in this particular form. Where you find that the bay background has appeared as red the different garment bags they have appeared as blue of course there are different shades, whereas there is a particular region over here which is appeared as again red.

Now again this is as Pseudo colouring technique which is applied to obtained this kind of image, and the purpose is if you have a Pseudo coloured image like this you can distinguish between different objects present in this particular image. And in this particular case normally the kind of transformation function for red, green and blue which are used are given like this.

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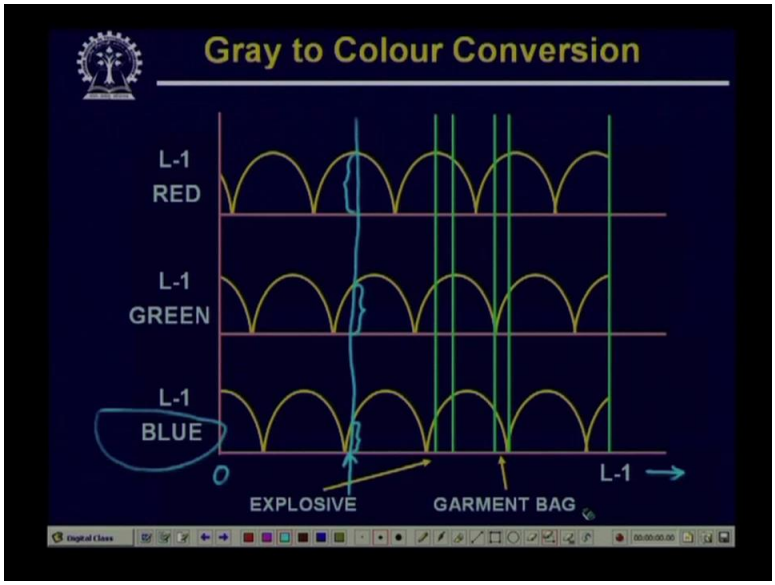

The transformation functions are usually a sinusoidal functions. So here what you have is you have this is the red transformations, this is the Intensity values along the horizontal axis, we have the Intensity values of grey scale image, which is varies from zero to the maximum value N minus 1.

The top curve sinusoidal curve it shows the red transformation, the middle one shows the green transformation and the last one shows the blue transformation and here you find that these different sinusoidal curves it appears as to be a fully rectified sinusoidal curve is shifted from one another by certain amount. So as if we have given some phase shift to this different sinusoidal curves.

Now when the transformation are given like this so if you have an Intensity values is somewhere here then the corresponding red component will be generated as this value, and the corresponding green components will be generated as this value, and the corresponding blue component will be generated and as this value. So this particular Intensity level will be coded as a colour point as a colour pixel having red component given by this much, green component given by this much and blue component given by this much.

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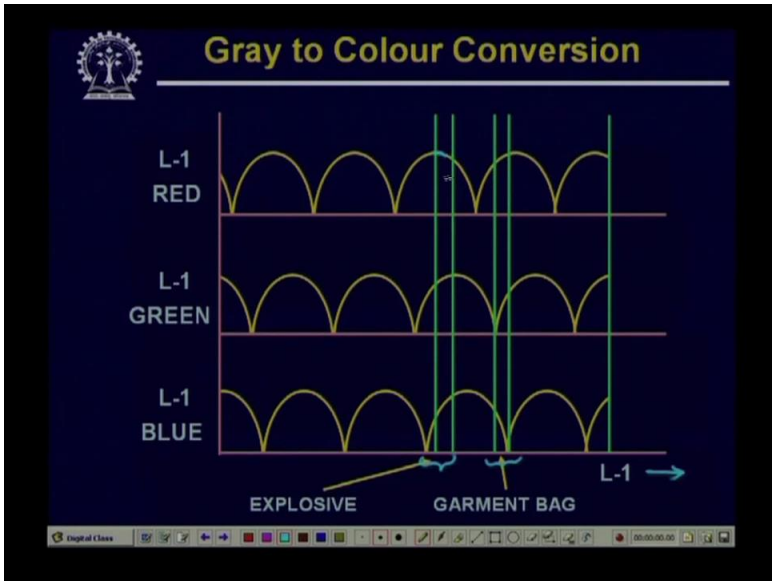

Now what is done for this Pseudo colouring purpose is that you define different bands of (())(22:19) Intensity values and the different bands so are given to different objects. For example a band somewhere here, the band somewhere here this is for identification of a say an explosive, a band somewhere is for identification of a garments bags and so on. So here you find that if this is the and which is given a which is used to detect the explosive the amount of red light which is generated, the amount of red component which is generated by this particular band is the maximum one.

So an explosive will appear to be a red one, whereas for this particular one which is for the garment bags where the red component is not as high as this so this will not appear as that red as an explosive. So different band of frequencies are identified or different bands Intensity values are identified specified to identify different types of items and by using this kind of transformation we can distinguish between different objects which are there in the bags.

So by using the Pseudo colouring techniques, we can give different Intensity values to different Intensity ranges and as we have just seen that we can convert a grayscale or an Intensity image to a colour image, where the colour image as it is as Pseudo coloured image. It will not really have the exact colour component but this Pseudo colour image give us the advantage that we can distinguish between different objects present in the image from its colour appearance, thank you.