Rapid Manufacturing

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Lecture – 17
Laboratory Demonstration, 3D Scanning (Part 2 of 2)

Good morning. Welcome back to the lecture on 3D scanning and we are in laboratory demonstration we had discussed about the artec 3D space spider scanner in the previous lecture it was a Puddle scanner.

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In this lecture we will discuss about Picza scanner which is a scanner that is enclosed in a cabinet just for the reason that it has a red light which is harmful for the human. So, that was a portable scanner in that object can move the scanner can move to anywhere this is a tabletop scanner that is kept in the lab only. This is Picza LPX600 model scanner the scanner cannot move anywhere. Whatever we need to scan, we have to keep it inside the scanner and scan will take place.

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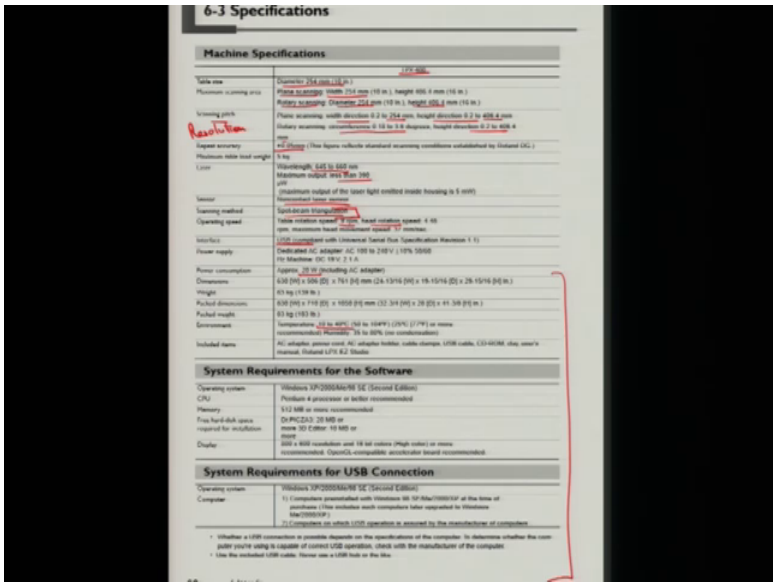

It is a red light scanner with these specifications this is LPX 600 model the table size is 254 the maximum scanning area of a plane scanning is the width is 254 mm and the height is 406. So, for rotary scanning the diameter is again same and height is same with 2 kinds of scanning plane and rotary.

In plane scanning the table is fixed in rotary scanning, the table also rotates we can select these options from this software when we will work on that doctor Picza software is also supplied by the same vendor. So, repeat accuracy is plus minus 0.05 for plane scanning which direction this is scanning pitch which pitch with which direction for plane scanning given 0.2 to 254 mm height direction is 0.2 to 246 mm for rotary scanning circumferential pitch is 0.18 to 3.63 height direction is this, this pitch is actually resolution that I mentioned in the previous lecture.

So, this also needs some soaking time, so these are the specifications the wavelength of laser is 645 to 650 nano meter maximum output is less than 390 micro watts. The sensor is non contact lens sensors spot mean triangulation method is used here the triangulation reverse engineering method is used which is a principle of working of this scanner.

So, table rotation speed is 9 rpm all these specifications are here. So, the important specifications are the interface is USB we can get the data in USB as well and power consumption is only 20 degree and the temperature at which it works is 10 to 40 degrees, the other specifications you can see this.

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So, the soaking time in the case of handheld scanner was the temperature for the laser to get heated and get excited. The soaking time in this case is differentiation, differentiation of the different orientations because the camera is moving in vertical direction and also the table has to be move it taken to homing that is there in CNC machines.

So, this differentiation it calibrates or it just take check all the dimension whether it can go up to 400 as 6 and millimeter height or whether the whole scanning can happen up to 254 millimeter. So, this is that that happens in the time next is we have a blue button here this is the button that is there in the scanner when we will switch this on you can observe these are the specifications or the indications from the button.

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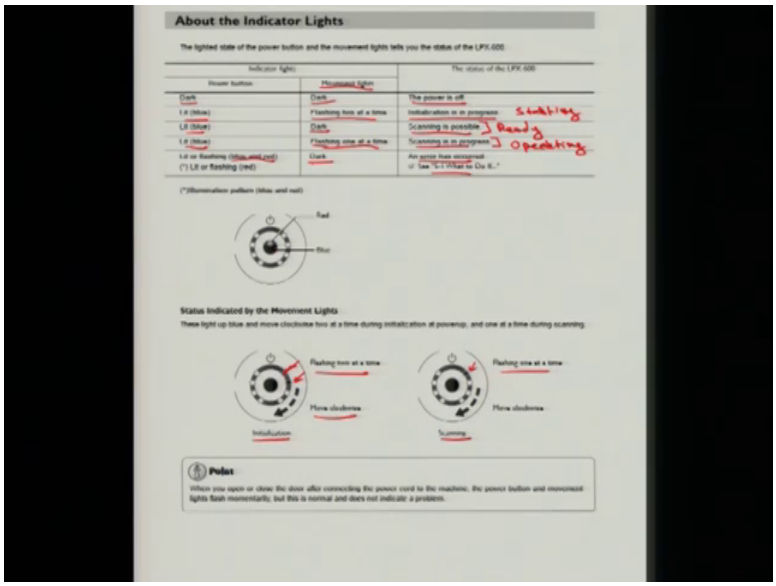

When a button is dark that means there is no light the machine is off the power is off, when it is lit blue this is read this is blue when this is blue; that means and it is flashing 2 at a time that is initialization is in progress the equipment is getting started only, so that is initialization. So, when it is it has initialized the scanning happens the scanning is in progress it is flashing one at a time and it is lit blue, when it is lit blue and the movement light is dark this is a movement of lights.

So, movement of light if it is dark then scanning is possible that it is it is ready for stand scanning ok. This is starting this is operating the scanning is happening and if the lit of flashing light is blue and red light is also there and the movement of movement is dark that means some error is there.

So, this is the difference status that can have flashing 2 at a time move clockwise, so that means the initialization it is flashing 1 at a time 1 at a time this is one at a time is flashing this is 2 at a 2 lights are flashing here this is one this is second if this is one is flashing 2 is flashing means it is initialization one is flashing means it is scanning and it is moving clockwise.

So, when will start this machine we will observe these indications. So, this is the inside of the scanner, this is the table top this is table top which is rotary table. So, the camera is fixed here camera is fixed here this is receiver in the inside we will try to zoom it and show it to you it is a receiver this camera and receiver are at 45 degree angle. So, there

certain specifications the optimum angle between the camera and the receiver is 45 degrees.

So, what happens in there this is the slicing way like I said in the CMM we have different slices we had 4 contact points for the circle, then we took our probe at a at a little high done a gap have another 4 points. So, this is in the similar way we have different slices this is no roster there is no overlapping.

So, it all depends at what is the pitch that we what is the distance between the 2 heights that we are giving or in the circumference also there is some degree when we are talking about the rotary object, when we are talking about need of the object we are just talking about the distance is height and length. What is the pitch between them it all depends upon that, but these are different slices like different pages are aligned and those are then brought together to a solid object. So, this is what happens here.

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So, you can see in the zoomed view this is this is the camera this is camera and at the further end we have a receiver here this is camera this is camera that we have here, receiver is at the further end there here we have receiver this is camera this is camera they are fixed at 45 degree now. So, but the exact angle or the act perfect angle is 45 degree here; but yes, we can have different angles different angles.

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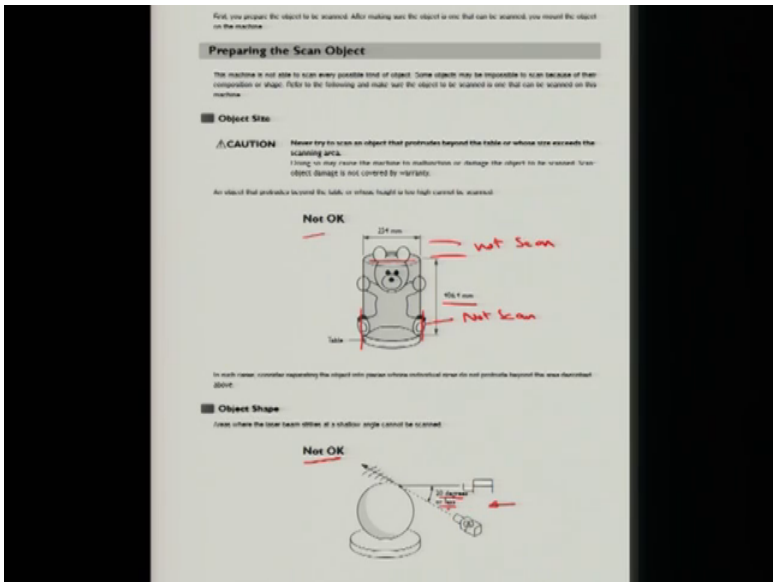

But the angle cannot be less than 20 degrees as is mentioned in the manual here, it is not if the angle between the receiver and the camera is less than 20 degrees also as you have seen the rotary table the object should not go outside of the volume though this is not, this is 406 mm this is not it will just scan up till this level.

So, above this level it will not scan this thing it will not scan. So, any object that protrudes beyond the table and height is higher than the specified maximum height it cannot be scanned, an area where laser beam strikes at a shallow angle can also not be scanned this angle the minimum angle that it can scan is 20 degrees.

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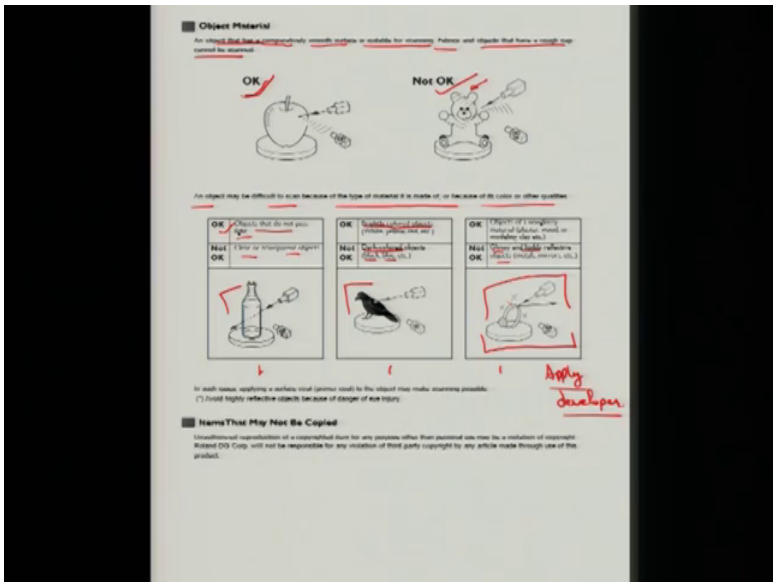

Also the object cannot be a fabric no fluffy it is mentioned here actually the fabrics and objects that have rough nap cannot be scanned an object that has comparatively smooth surface is suitable for scanning. So, this is not this has smooth surface this can be scanned this cannot be scanned because, it would not reflect the light back to the receiver.

The certain other tips the objects may be difficult to scan because of the type of material it is made of because of it is color and other qualities, this is a transparent object this cannot be scanned. The object that are clear or transparent cannot be scan scanned, the objects that do not let the light to pass through them can be scanned those are and also dark color objects like this is a black object again the similar thing that I have mentioned in the previous lecture this is black color and that would observe the light so this cannot be scanned.

So, if there is a dark color that again has to be applied with the developer as we saw in the previous demonstration. So, this cannot be scanned black color cannot be scanned bright color objects can be scanned, so dark color objects cannot be the black and blue also is mentioned by the vendor.

So, glossy or shiny objects cannot be scanned you can see this is a glossy as we had aluminum in the previous presentation so this cannot be scanned. So, these are certain

cases where we need to apply some coat or some primer course or some developer to scan, in all these 3 cases we can apply developer right.

So, this is the dummy this is the toy of crow this is not the actual crow because, this is a red light that would be harmful if it come into contact with any living being humans or animals, so that is why it is a close chamber scanning. So, these are certain tips or certain restrictions to the scanning.

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So, this is the object that we are gone a scan here this is the holly figure. So, this is the model of a holly figure and this is all in white color. So, this can be scanned easily we need not to apply any coat or developer here, we will just put it in the center of the work table and try to scan this. Let us put it here and we will just like try to put it at the exact center of the table.

Now the camera would put the light and receiver would receive the light back and it will try to scan let us close the door of this chamber.

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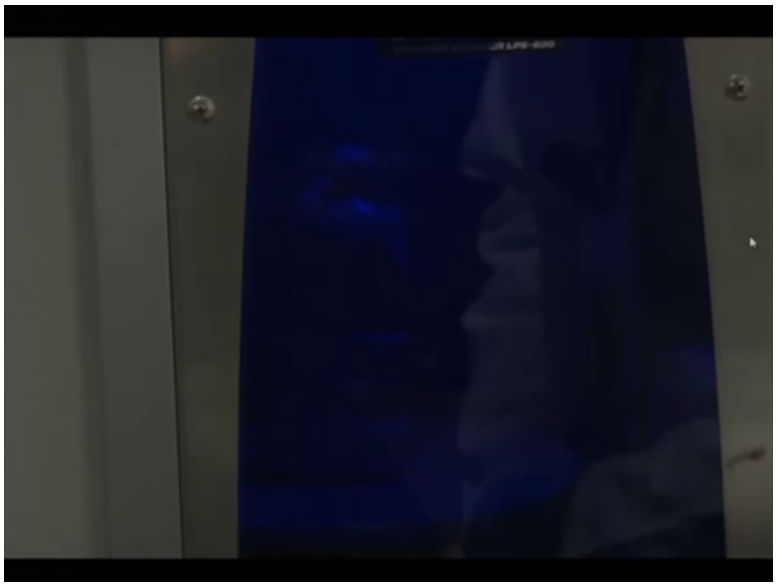

So, the closed door is closed even you can observe that the door color is blue, we close blue will cancel to some extent the harmful effect of red light so that is there. So, when we switch it on the initialization happens this is initialization the 2 lights here.

If you can see the everything is moving here so this is this is preparation of this mesh the machine and homing is happening this is rotating complete rotation of 3D 360 degree has happened the camera is moving up and down, some light is coming on here and getting light back to checking everything.

So, to make sure that will be the machine would work properly this is initialization in initialization the start button was blinking which 2 lights on, so now we have put the scanner object inside the scanner and we are come to our computer interface.

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Here we have doctor Picza software this is the shortcut for that, so we will click on this.

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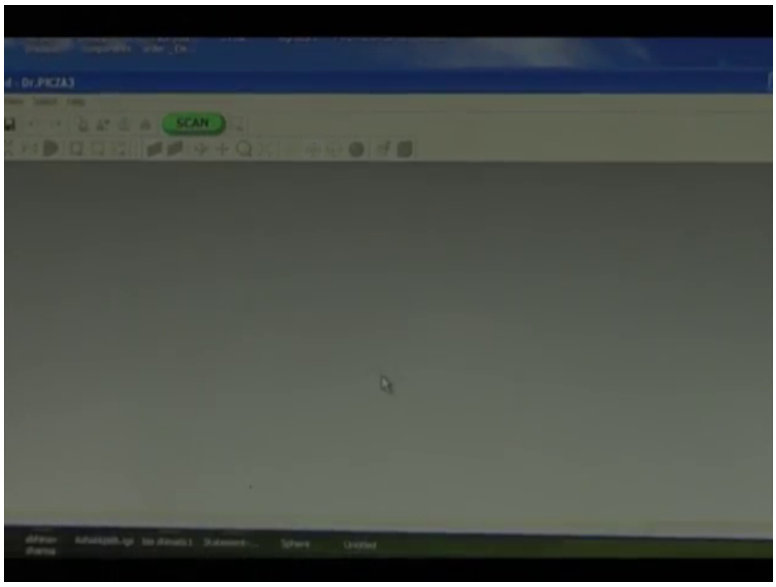

So, this is software that helps to scan the object you click there and this interface is opened. So, we this option this is a big button here scan green button we will click this button.

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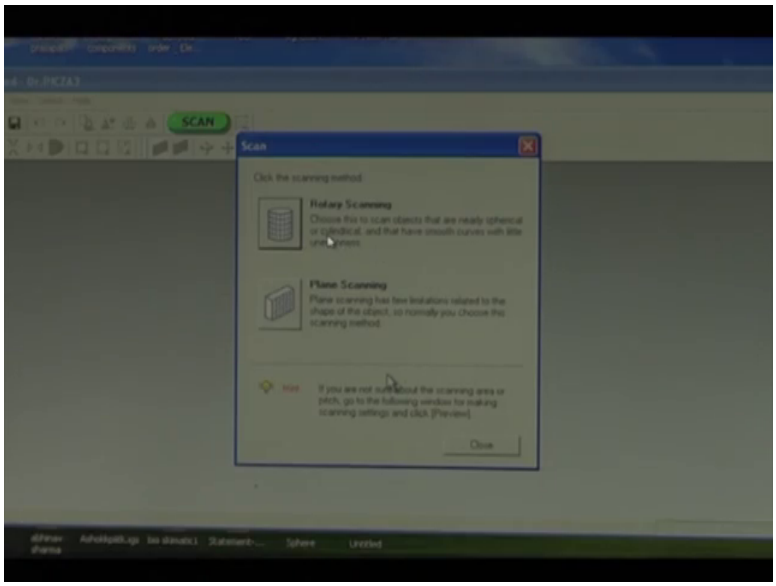

When we click this button it asks for certain options rotary and plane scanning, rotary is when we choose this can scan objects that are nearly spherical to or cylindrical and have smooth curves with little changes. Plane scanning is the scanning when we have few limitations related to the shape of the object, so normally you choose this scanning method.

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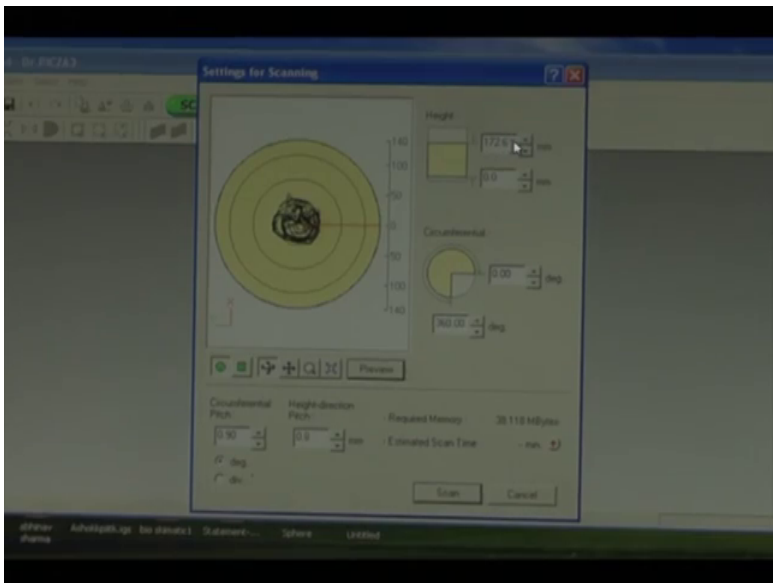

So, our object in this case is not a rectilinear or the planes object. So, we have we will choose the circumferential option or a rotary option. So, here also it is showing the pitch

this is rotary this is rotary or plane, so for rotary it is asking the pitch here the circumferential pitch and height direction pitch then height pitch is at what species is the slices in the height in the vertical direction placed. So, that is first we can have 1 mm then 1.2 mm then 1.4 0.2 would be the pitch there, so this is the kind of resolution that we saw in the previous lecture.

So, this is given 0.9 here as default pitch, so that circumferential pitch is actually given in degrees not in mm it is 0.9 degrees. So, circumference rate rotation is 0.9 degree per scan per scan data and the camera is going up and down there is controlled by this that is 1.0 mm is the pitch one after one it can do 2 it will have all the slices at one mm distances.

So, the maximum distance that it can scan here is 4 or 6 0.4 mm it is mentioned here. So, we are changing the pitch here 3.2 is a pitch there was just changing the pitch randomly, just to show you how the pitch is changed we can increase or decrease the value of pitch here in mm and in degrees or divisions in circumferential it is 0.36 degrees. We can increasing it into the 0.18 point 1.44 0.90 it is just changing in this way.

This the resolution for circumferential pitch is 0.18 degrees 0.18 degrees is a minimum value that we can put in and for the height it is 0.2 sometimes we are not sure about what is the height of the object we cannot have this height. So, what we can do we can preview the preview button is here we can preview because, we 4 or 6 is the maximum height that it can it can scan and we need not to scan the whole height, but that will only the consume more time.

So, we can have preview to see the maximum height that we need to scan. So, preview if we killed prequel it is it has started scanning it is just a quick scanning or the check of the height of the object it is not the exact scanning you can see the preview is happening it is scanning. So, you can see the scanning is happening so this is scanning the light is rotating single flash is there.

Now, the scanner will read the actual height and diameter of the object and tell us and we can fix that height we need to go up to 406 mm, it will decide the height we can fix that. So, this is sizing or acquiring the exact size of this scan this is just a preview that is happening not the actual scanning.

So, when scanning would take place it will scan the exactly what the preview data has given the input into that. So, this is a rough scanning the camera is going up and down camera is here now. It is checking the height of the object table is rotating here, so the table will rotating and that is describing the circumferential geometry and camera is detecting the height.

So, those things are being defined here in the screen also it is showing the progress, it has shown that around this much 29 percent of this scanning in the preview phase has happened that is showing the progress are now 41 percent.

Now, 43 45 this preview is happening here also we can see one thing it was showing 4 and 6 here 406 millimeter. Now it is showing 172 172.6 here 406 mm. So, it will just scan up till this height the maximum height that it will go, so it has measure the height of the object up to a single place of decimal.

So, here we can see the diameter as well diameter is from this is the central line tights from minus 50 to 50 it is less than 100. If 50 comes here 50 is this line so it is also 50 it is around 80 or less than eighty mm dia is there. So, when we go for scan what will happen it will just it will just read this dia only this dia and this height it would not waste time in reading all these dia and the height up to 406 mm.

If you do not go or choose the preview option it will just scan the whole volume in the chamber, so let us start the scan. So, I fit the fix the height direction is 0.8 and circumferential pitch is (Refer Time: 22:01) and we have started scan it is now processing now it is receiving the data processing it will receiving the data.

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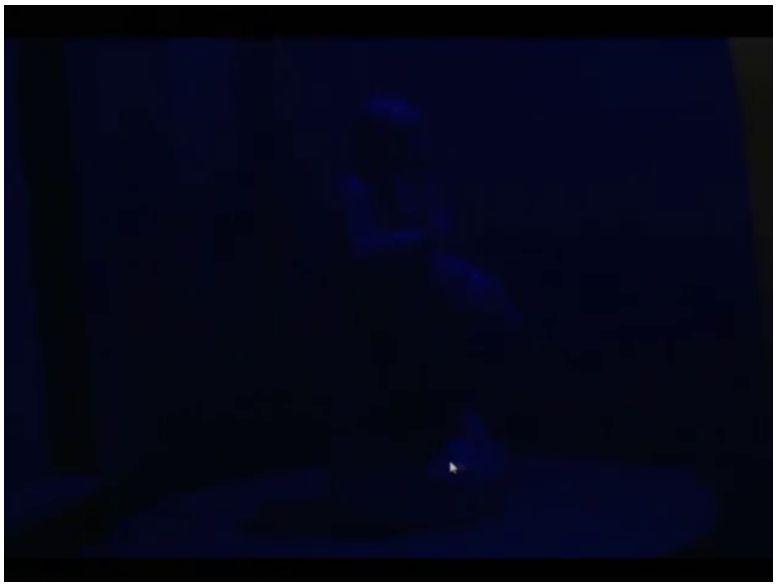

We can see that a red small red dot would come here it has started from the bottom and it is trying to getting this slices towards height. So, it is very one you to very small light now with a naked eye it is because it is the object is having striations or different profiles here we cannot just see it all the time, but at some point it will definitely come here I will try to show you when it comes it is rotating and light would be around here. But here because it the scanning is starting from the bottom towards stop, so light would be somewhere here it would come.

So, it is close to the foot of the object that we are scanning the foot of the body here. So, it will come around here yes here we saw just saw the light, this is the red light this is a red light. If I try to rewind this yes here you just saw the red light it just move from this point to this point, so this is the red light here.

So, this is a red light that moves from this point to this point. So, this is the scanning it has happening and it has reached up to around 20 mm height from the base and this is how the scanning is happening. Now we will scan the whole model because it will it will take some time it will scan the whole model and get you the data that is generated on the computer.

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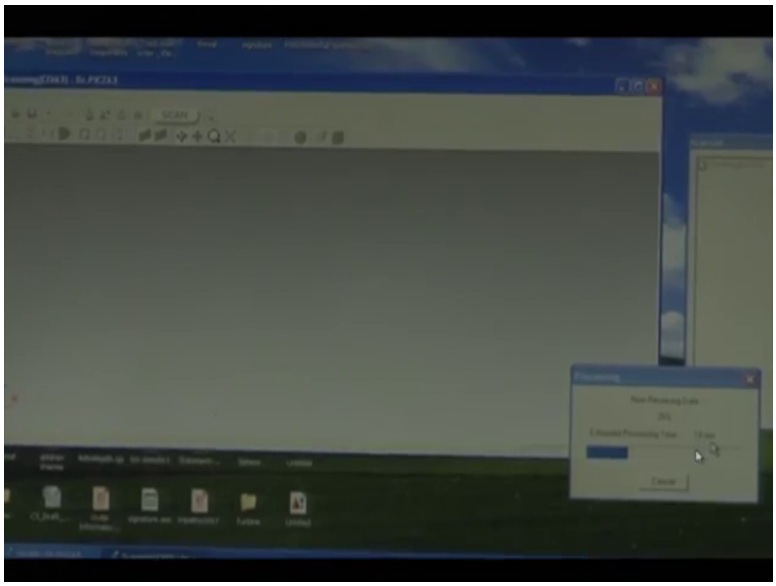

The scanning is happening the scanning is happening and around 25 percent scanning has 26 percent of scanning has happened estimated time is around 19 minute processing time is. So, to total job was above around 28 minutes and 19 minutes is left. So, it has received around 27 percent of data till this point this is scanning is happening this is showing the progress of the scanning.

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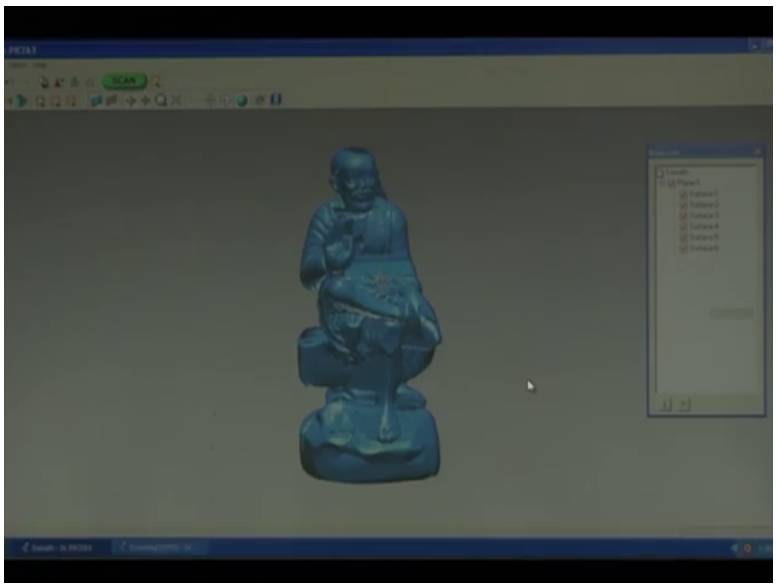

So, this we have obtained the scanned data and full scanning has happened you can see the body look likes this. So, this is the model with all the noises and all the errors we

have not cleaned the data. You can see that there are certain noises here certain noises here ok, this is also the unwanted lines these are the no these are the noises or the errors here also there are certain errors.

So, that that would come in this complex object when it has be simple or just no just a cylinder some errors are come because, it could not detect it could not detect this vacant space behind the hand of the object it could not detected this.

So, we need to work on this also here also there is some recession some material has not come., so that can be worked easily using different tools here. So, for modifying and rectifying these errors we save the data in a useful format and go for the modeling, where we work on the patches and surfacing and we develop the solid surface properly and we remove all the noises.

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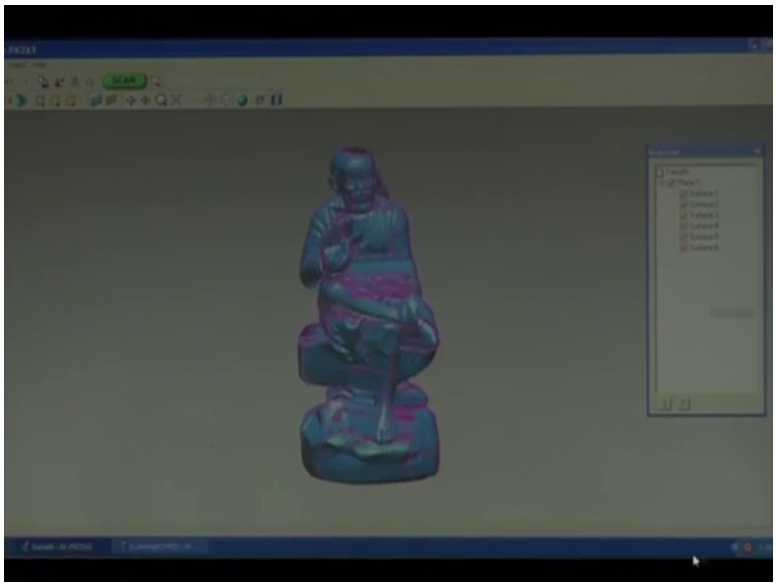

You can see this view also these are the colors red lines show that some depth or some errors are there. Some noises are being shown here this is only to show that there are certain noises are there, so this is the scanned data or point cloud data.

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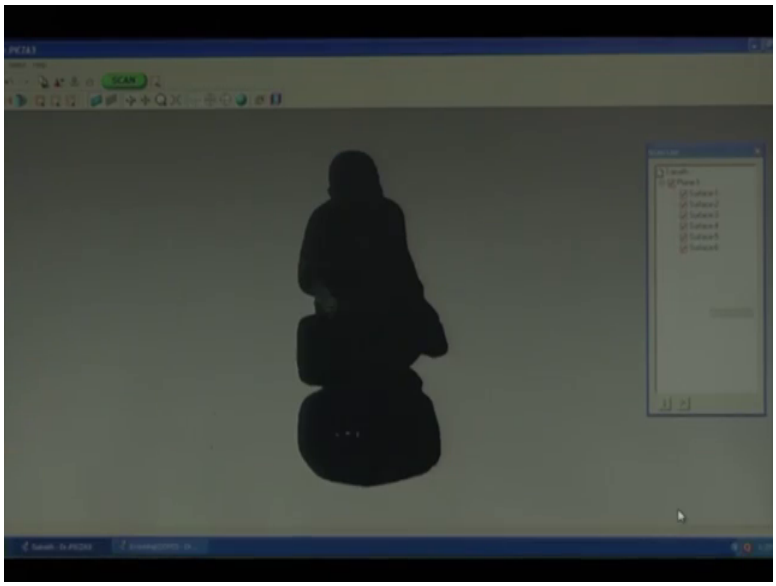

So, this is point cloud that is shown here, so this is point cloud it is showing the data in the from the point has in the multiple points are being shown up and you can see because the points are 2 dens. So, that is why it is showing the complete black if which you can see this points are here this points have generated. So, what we called the noise that is obtained from these points only it has developed a solid from this points. So, this is from point cloud data we can see the very less dense cloud and remove it from there, so that can happen very easily.

So, automatic surface generation has generated this surface here you can see this surface has generated here. So, it has made it a part of the object which is not there, we can remove this points we can just select this volume these dots can be removed and can be worked on.

Now these are some unwanted dots there are certain points where the data might be missing when it will add some patches there so all these need to be worked on. Those are supporting software's are also there that helps to work on this, this is just the software that is provided by doctor Picza doctor Picza 3, the name of the company is Ronald. This software's helps to develop the model for cam for computer aided manufacturing and for 3D printing these can be used directly.

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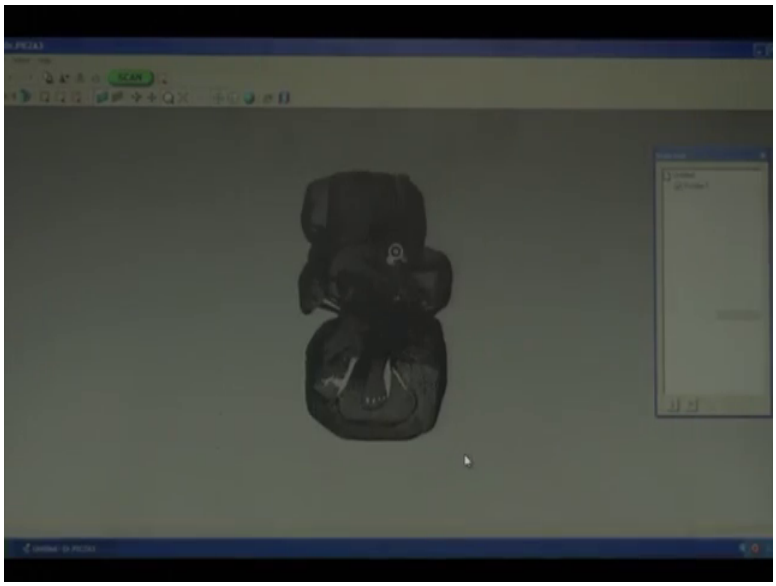

So, this is the mesh form of the data this data in the mesh form of the object this is a raw form of the data when we these are the patches those need to be worked upon. So, this is density so these are all pixels in a way. So, these are empty spaces patches are need to be put on, so this is the way we have produced the data.

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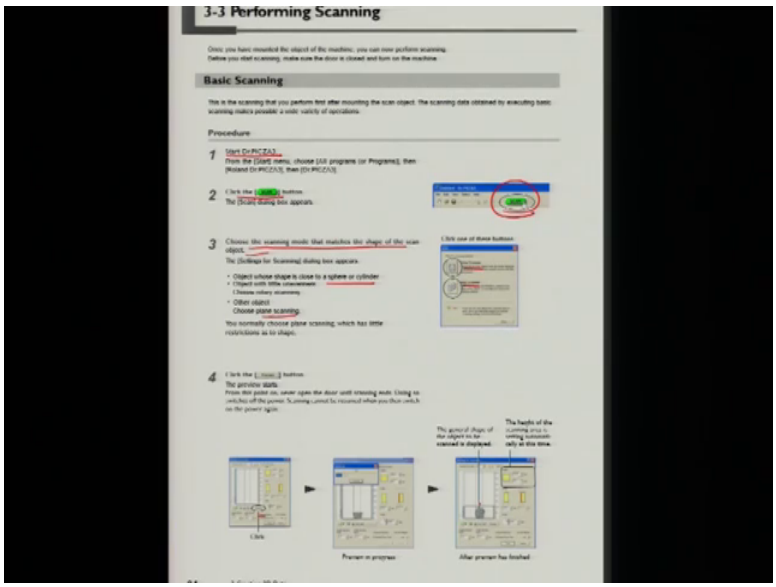

So, this is the manual it is provided by the vendor they have just mentioned this steps that we just saw, you just start the machine then we click on the scan button these window opens, the we choose the scanning mode that is either the rotary or plane

scanning and the object whose shape is closed to sphere or cylinder can be used in rotary mode other objects go in the plane mode. Then we click the preview button to finalize the height and the width or the radii or diameter of the objects.

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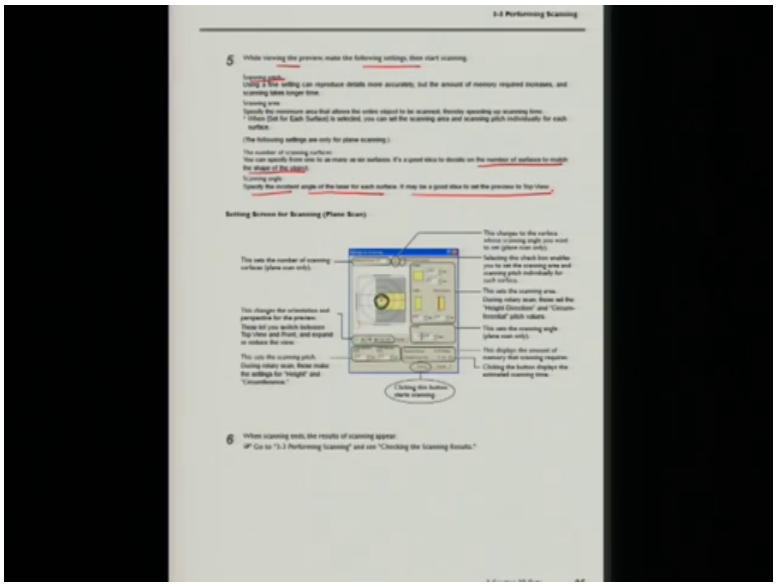

So, is the 4 general steps the fifth step is while viewing the preview we need to do following settings we need this do select these scanning pitch is a pitch or not, we need to finalize this thing. Then we need to just scan properly this we can even specify from 1 2 as many as 6 surfaces when a scanning, it is good idea to decide on the number of surfaces to match the shape of the object this scanning angle as we have mentioned is the angle of the laser free surface it may be good idea to set preview to top view.

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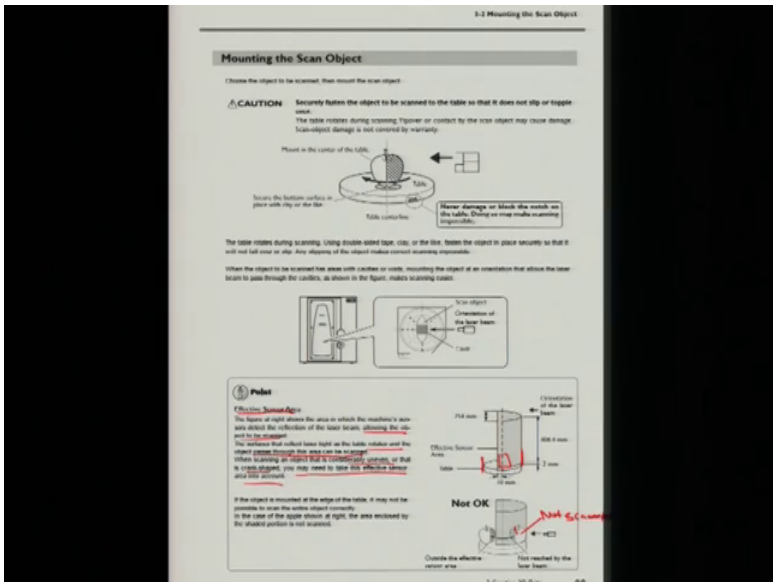

So, before this I like to mention one more thing effective sensor area. Now the figure at the right here shows the area in which the machine sensor detective reflection of the laser beam align the objects to be scanned ok. The surfaces reflect that the laser light as a table rotates and object passes through this area can be scanned, when scanning an object that is considerably un even or that is crank shaped.

Now you may need to take this effective sensor area into account now this effective sensor area is this here, this is the table now this is not effective for a vector sensor area it is not recommended to keep the object at the side that is why we kept the object at the center here. So, if the object is mounted at the edge of the table it may not be possible to scan the entire object correctly. So, in this case the apple shown at the right of the area enclosed by shaded portion is not scanned this is not scanned ok, this is effective area though the table is this big table is this big but this is not scanned.

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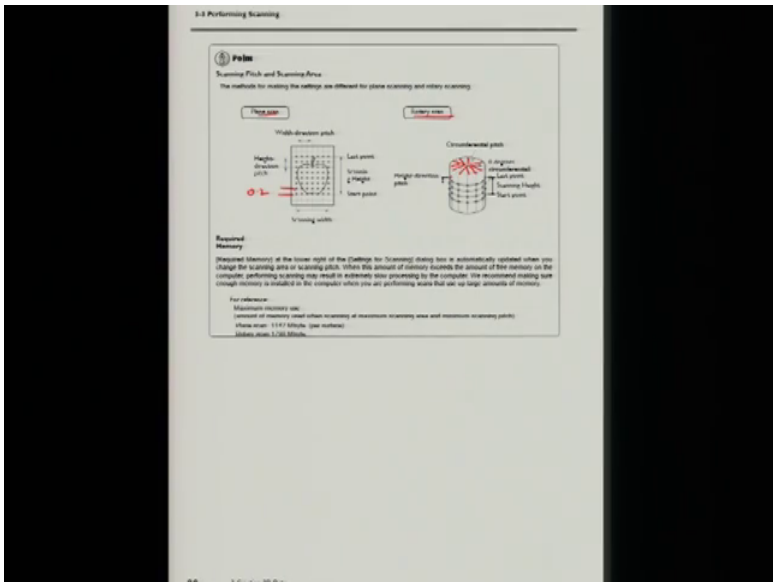

Now, this is it is showing how does the pitch work in the plane scan and in the rotary scan in the plane scan it is kind of a grid this last point and the start point this height is the pitch, the minimum pitch is this one this is the minimum pitch it is 0.2 this is circumferential pitch. So, this is at what degree does the data gets corrected.

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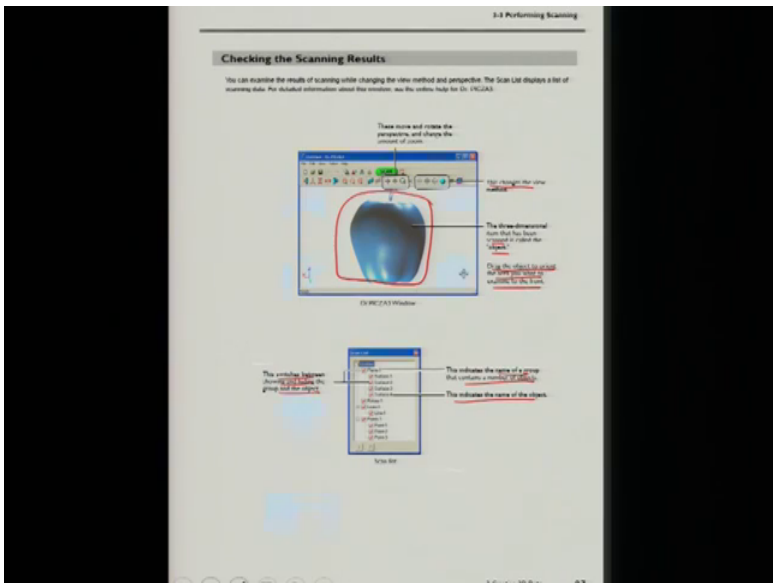

There are certain things which are not shown in the laboratory to brief a few of them which are there in the manual here. So, this is how we check the scanned results, like we showed in the demonstration.

We get this scan result that is known as the object, so this scanned is known as object we drag the object to orient the area that we need to examine in front, so we can select different surfaces. So, this plane indicates the name of the group that contains the number of objects this indicates the name of the object. So, this switch is between showing the hiding the group of the objects.

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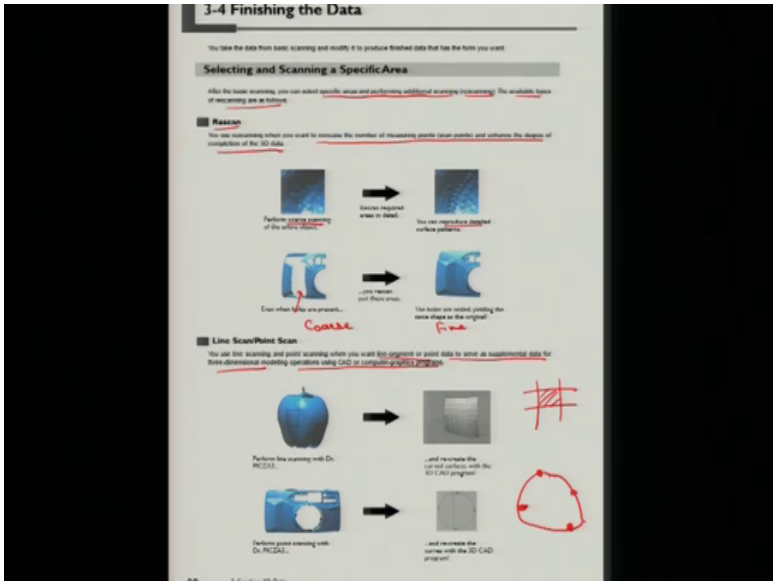

We can scan different objects and get them put together into one. So, selecting and scanning a specific area [noise, so we can scan and re scan and again rescan to select the specific area. So, after the basic scanning one can select specific areas and perform additional scanning or Re scanning, the variable types of re scanning are as follows number one is Re scan we use re scanning when we want to increase the number of measuring points. So, scan points and enhance the degree of completion of 3D data.

Because the pitch is limited sometimes we need more details at a specific point for instance in this camera in this scan this data might be missing. So, we re scan at this area in this case we force which is the Course scanning this is Fine scanning this is course and this is fine.

So, line scan or point scan sometimes we use Line scanning and Point scanning when we want line segment or point data to serve as supplement data for 3 dimensional modeling operations using cad and computer graphics programs. So, these can also happen we perform the lines scanning at the specific area and get this only this density area.

So, also we perform the point scanning here and we can just have the 4 points here 1 2 3 4, line scanning is we have just made one 2 3 4 lines in between this here the scanning would happen again and point is we get 1 2 3 points and 3 are the minimum number of points that can help to develop a circle, this 3 points can help us to make a circle and this circle can be scanned like in this case ok. In the scanning we take 4 points actually like in coordinate measuring machine we took the 4 points, in cad drawing there are 3 points when we draw using any software or auto cad.

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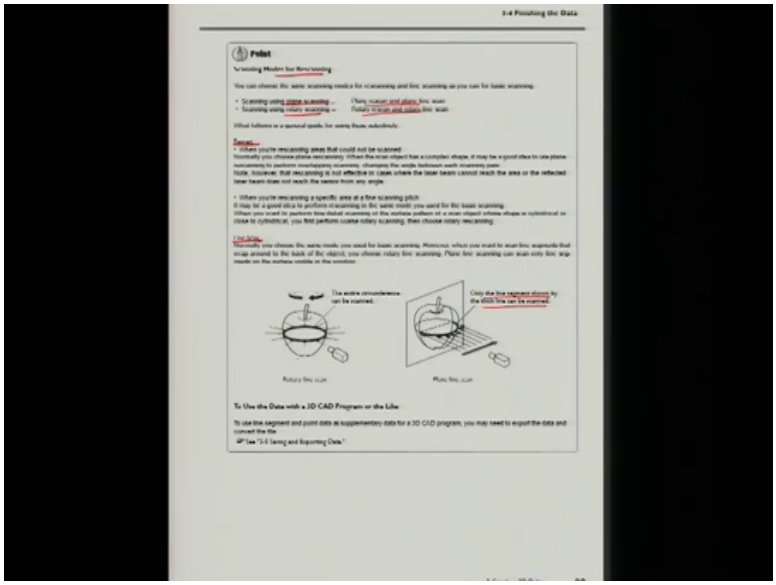

Next is scanning modes for re scanning using plane scanning using rotary scanning, plane scan or re scan can happen rotary scan can happen you can go through this manual this is rotary line scan the only the line segment is shown by the thick line can be scanned. So, these scan re scan or line scan can also happen re scan and line scan. So, when we are re scanning the areas which could not be scanned see we choose normally Plane Re scanning, when object has a complex geometry we can even use the rotary re scanning.

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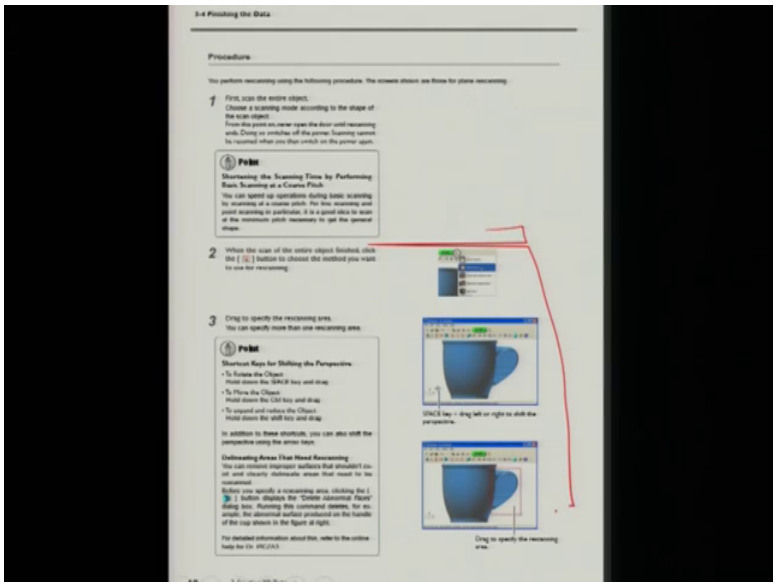

So, these kind of scanning's can be selected accordingly they are different methods you can go through this.

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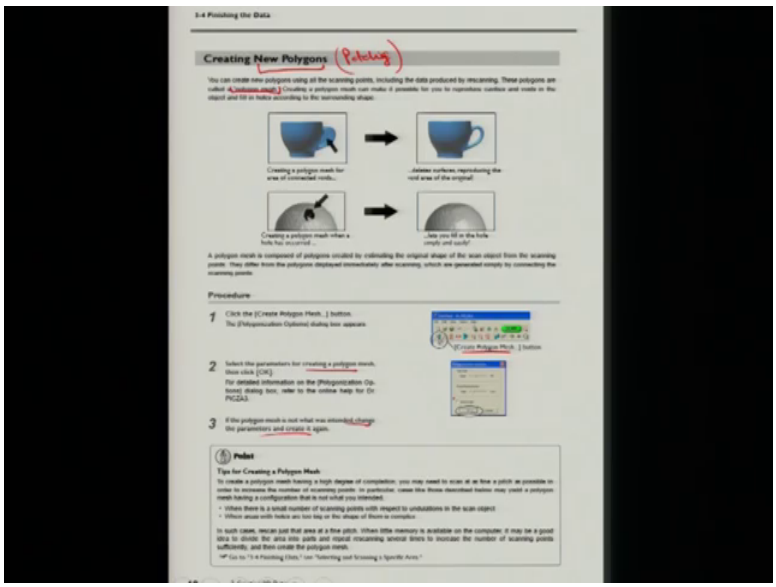

We can also create new polygons as I said patches this is known as the which is patching kind of patching ok. For instance if it is missing here as you saw in the head of the sculpture that we scanned this there was it was something was missing in the head. So, we can generate additional polygons here we can fill it that happens using a command

called Polygon mesh command called Polygon mesh, this is the command that helps to add new Polygons.

So, here we have the polygon mesh at the left corner this is create polygon mesh and we select the parameters for the polygon mesh and detailed information of the polygon mesh dialog box opens, if the polygon mesh is not what was intended to change the parameter and create it again this is one of the features that can happen.

So, this is generally what we do general scanning we scan we get the cad data, we that is the point cloud that helps to generate the triangulation mesh that melt mesh helps us to get the surface which then helps us to get the solid modeling.

Then we saw the errors and solid modeling and start working on that, how to work on that either we can work in this similar same software that is provided by vendor or we can work in some other software that has a better capability in work on them and they are also automated modes to add patches etc.

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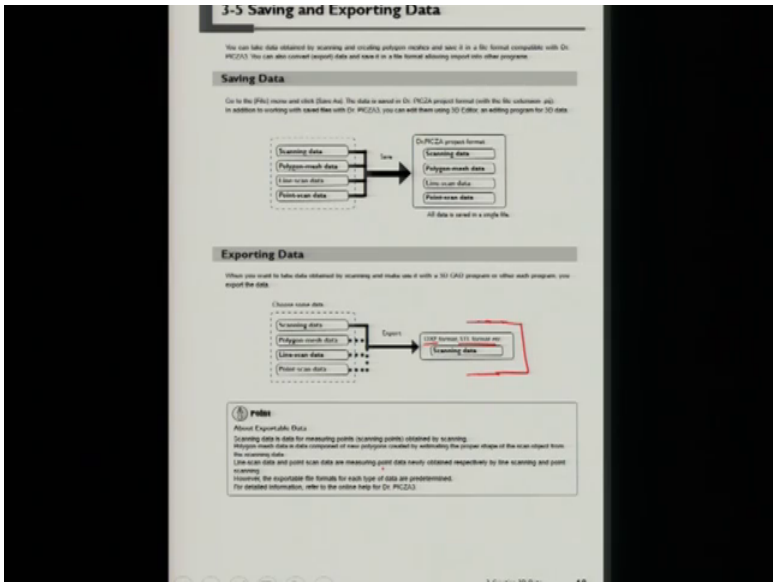

But this is a saving data and exporting data exporting data can help in DXF and STL format. So, as I said different other software's can help to work on the scanned model, so it can be exported in these ways DXF and STL in all and some other formats as well.

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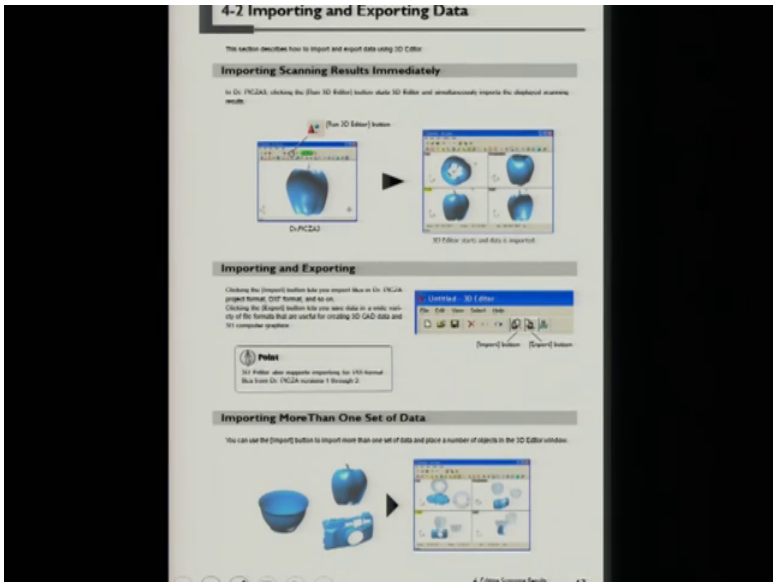

The certain editing of the data can be done.

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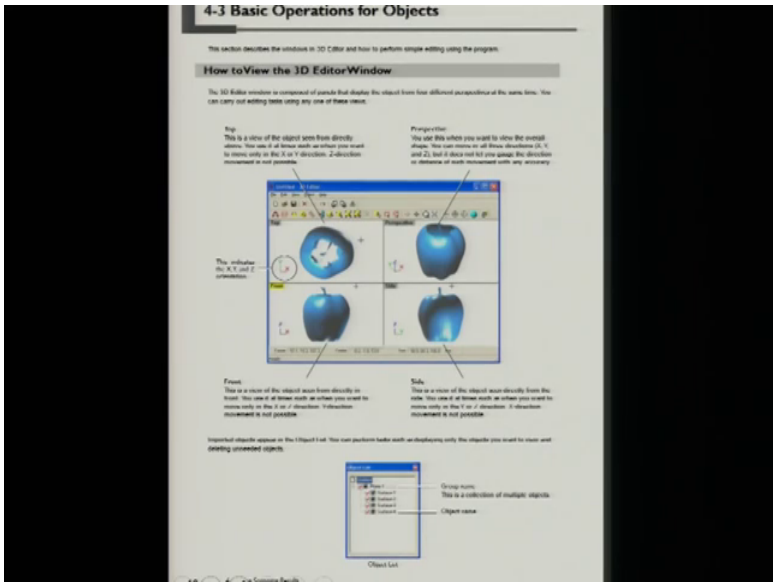

You can add patches

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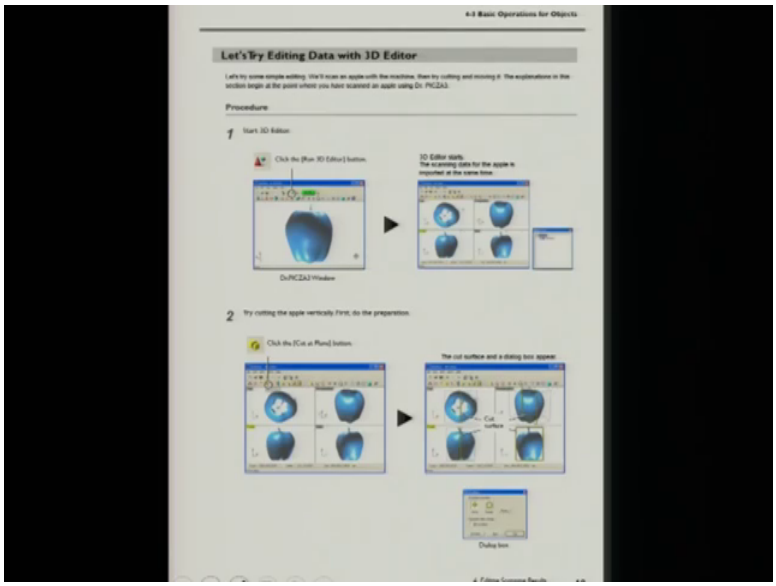

We can see different views these things are the more details that you can get to know if you read more about cad modeling or 3D scanning. So, this was all in the laboratory demonstration on 3D scanning we have not worked on the data cleaning and con generating the solid model completely we have not worked on all the command because, that would have an extensive presentation of may be 4 5 hours.

So, we have try to complete just in laboratory demonstration how to operate or work on the machine that is a 3D scanner which was doctor Picza LPX 600 model and the in the previous lecture we saw artec 3D space by the scanner and also we saw the coordinate measuring machine which is a contacted type of 3D measurements with this reverse engineering and 3D measurements parts is over.

Next we will start with the processes rapid manufacturing processes the very first process professor Ramkumar will discusses polymerization process, then we will come up with powder based additive manufacturing or rapid manufacturing processes that would be come in the next week and a few processes a couple of processes would be discussed in the forthcoming weeks.

Then I will discuss about rapid manufacturing materials then post processing concerns in rapid product development. Rapid product development we get the cad data we try to develop the product rapidly in which selecting the proper layout for additive

manufacturing is also important factory simulation can also happen, so these things will be discussed in the course further. So, let us meet in the next lecture in the next week.

Thank you.