Physical Modelling for Electronics Enclosures Using Rapid Prototyping

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Lecture - 20
3D Laser Cuts 1, Prints

Hello, let me continue where I left off in the last session, we started with trying to make a small enclosure which can house that small DC-DC converter which is used for running something. Actually I have a 12-volt battery, I wanted to connect it to a modem which works from 6, 9, 12 volts and so on. So then we manage to get this small thing. Now if you can kindly see this thing here.

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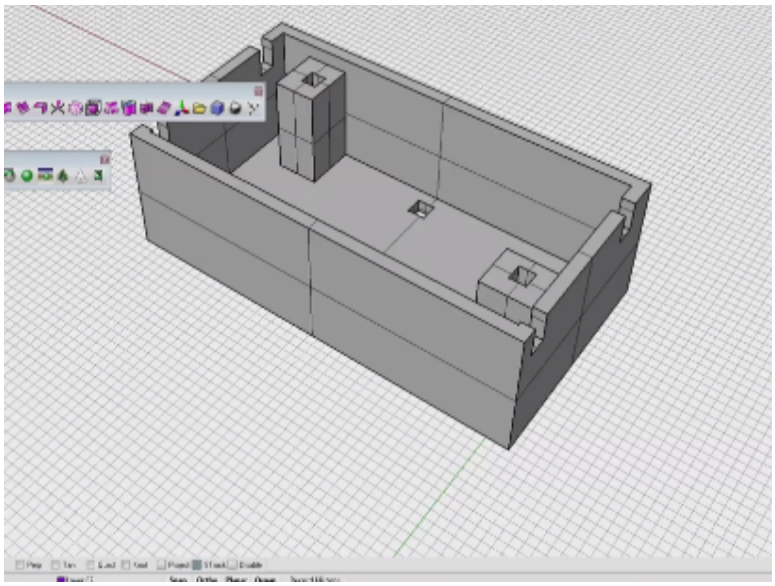

You will see a series of pictures which you remember this where I started with and then we went on trying to make various things and then at one point if you remember I stopped here saying I try to now make a small what you call a corner support and then I turn the printed circuit board over it and get it. Then when I went to the what you call to the printing machine, my colleague, Mr. Singh, has told me that while in principle this is okay, this is an over do. We can manage with finer features and so on.

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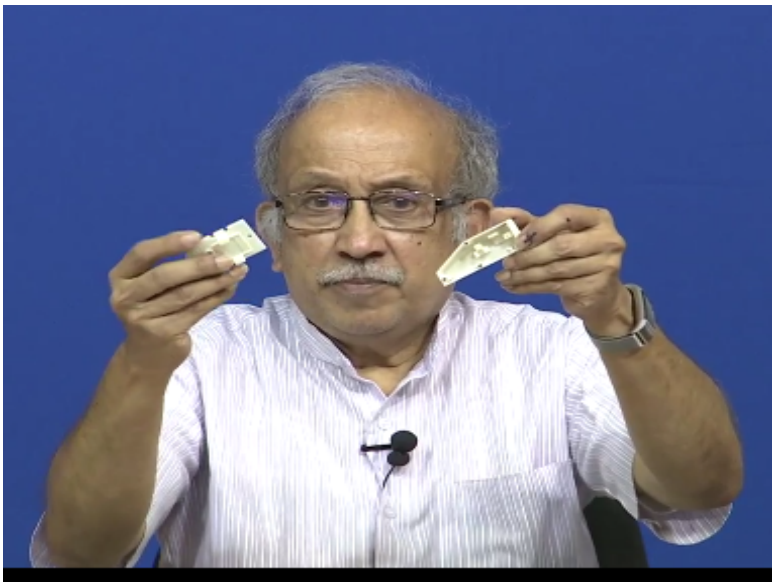

You see here I have an extremely compact and small unit. This is the type of features where thinking of and they are very, very small. We have a small knob here and same thing here we have some places for various things which are extremely small and this thing especially if you see a small this thing here. This is very, very, very tiny. So his feedback was saying the features are gross.

So all the (()) (02:38) of making something in plastic is lost. So you see the wall thickness, the wall thickness is you know very, very small, in fact there is a small lip also here. So that eventually when the box is made probably the box will sit nice and flush like this. So for such an item it is not correct to give such gross features as are there in that. So if you look at those features you will notice that they are not what you call proper compromise or what you call proper design.

So further if you remember we wanted to check whether you know the smaller thing like this with 2 supports here is better than having complicated what you call circular feature like this, so after due consultation we have found out probably this whole thing is overdo. We need to simplify it a lot. So I went back to the what do you call drawing board and try to make something see finally this is a simplified device of the same thing what you saw there earlier.

So if I now try to, you see several features have been added. One of them is that at the corners early if had a step which was given has been removed and all that semi-circular things have been removed and similarly when the wires of that what do you call DC-DC converter need

to be taken out. They need to be taken out from the sides, a lot of relieves have been given. This is the simplified version of the same box which have shown earlier.

So if I rotate it you will see that you know and then there is a singular after having measured the bottom and the various surfaces and all that finally we have an enclosure which is flat, which is simple. So this is where and this has been loaded on the machine there. Downstairs the whole thing has been taken and tried to load it on the machine.

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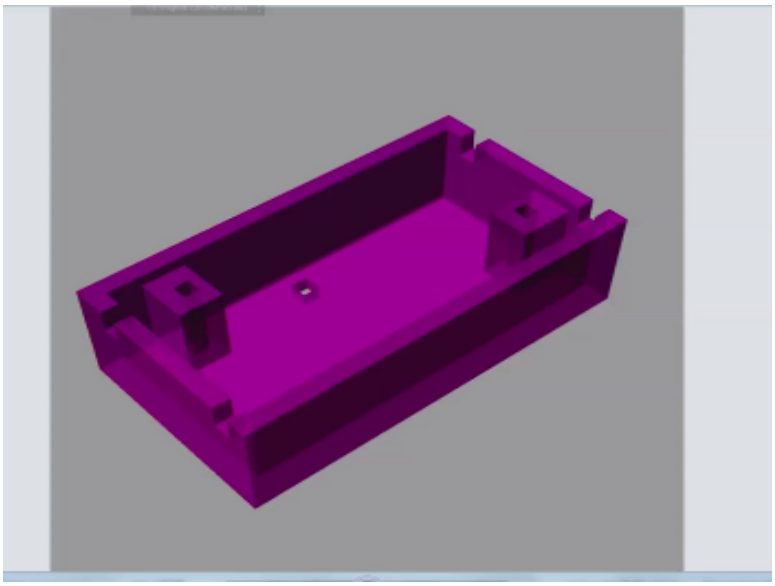

This is a transparent what you call a representation of a rendering of how the box is going to look where the purposes of our you know illustration the thickness of the walls has been shown is to be limitus here, but actually the actual I think in the drawing is only 1.4 millimeter, 1.4 is very, very thin this is typically about as thin as these items and it is strong, okay, quite strong, it broke, already it broke even before I pressed.

If it is supported in both places it is quite strong. So after having done this, this is the other side of the box and this is only for the purposes of illustration that box has been and actually you see here the wall thickness are little smaller. This is directly loaded on the what you call the 3D printing. We have a patch program which starts the point here. So my colleague is now working on that device, they are trying to load it.

And finally once the whole job has been loaded depending on the sophistication of the system and professional features of the system you will end up with a beautiful program which will show you how things are made. So if you see here at the bottom we have a line which both

the bottom timeline as well as number of slices how it is going to build and all that. The bottom most is obviously the very, very base point of it.

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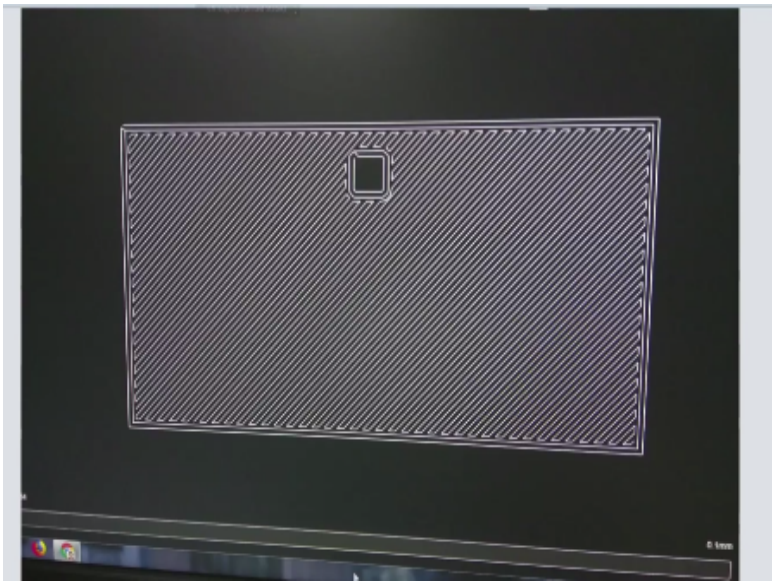

You see here that same what you call filament moves across and tries to fill the whole thing as much as possible and that whole square hole also know if you go a little closer will notice it is almost like a puzzle. So it starts here, goes here, goes here, goes around and all that and fills it like this. Same thing about all the features here. so depending on the buildup or how this machine builds the surfaces it is possible for you to give 45 degrees you know + or 45 degrees minus type of lines and to see how well it builds.

Here the indulgence is built into that machine.

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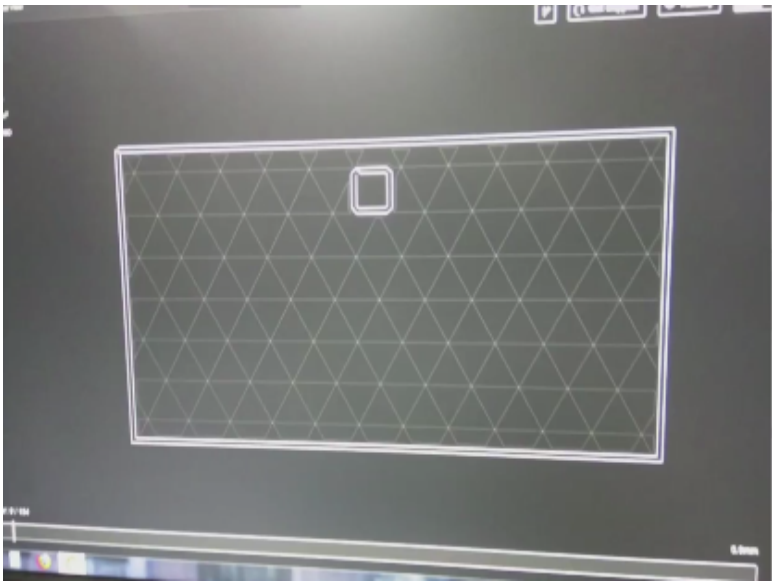

Next layer is, is all the filling up layer, what the filling up layer does is, see if you I mean the building layers you know shown here you can move it wherever you like, take the various slices. After the bottom most layer has been built next comes the, if I go back to this box here, you remember this in the 4 corners there are vertical grooves given and in the other places this is where the whole thing supports itself.

Now you see as much as possible we try to maintain the minimum amount of width here. So we have found after little bit of practise and consultation with the manual 1.4 millimeter seems to be strong enough and 1.4 millimeter also is the one which reliably the machine builds by having 4 passes and all. So it becomes you know reasonably fused while strong and all that. So the next picture will give you as these things build up it keeps on building up.

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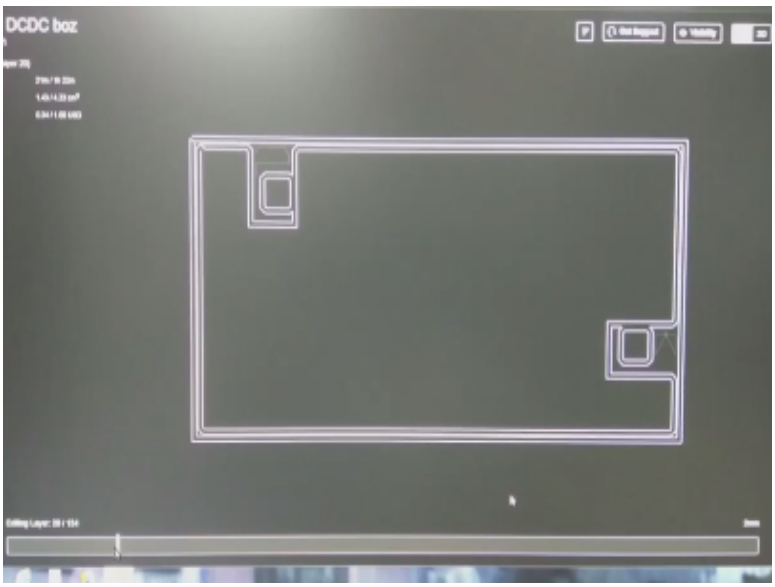

You see it is here at this point these things are all along layer on layer on layer this thing builds up and finally after this nearly coming to the top we will see that for the first time know these 2 gaps have started being built although this is the way that each layer the material is being built up. So just below that you have the other support of the other material. So beautifully you can make out how these things.

Actually know job has not been sent for what you call melting or the buildup or the printing. In the machine it is, I mean in the software itself know I can see if there are any problems and the next picture will show you it has finished.

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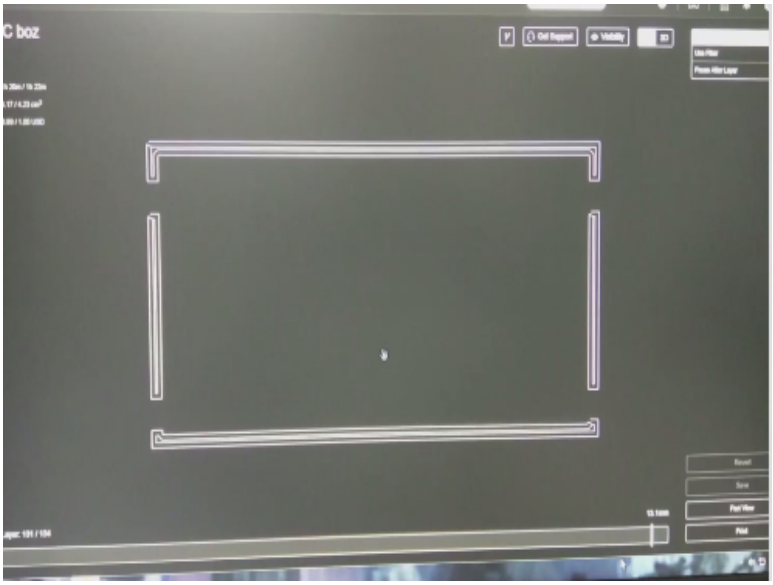

It has happily printed that features and we are almost come into the end here. Let me see if it is a surprise, if it is finished it, to the almost to the fag and finally the printed job is likely to look like this depending on the material you use.

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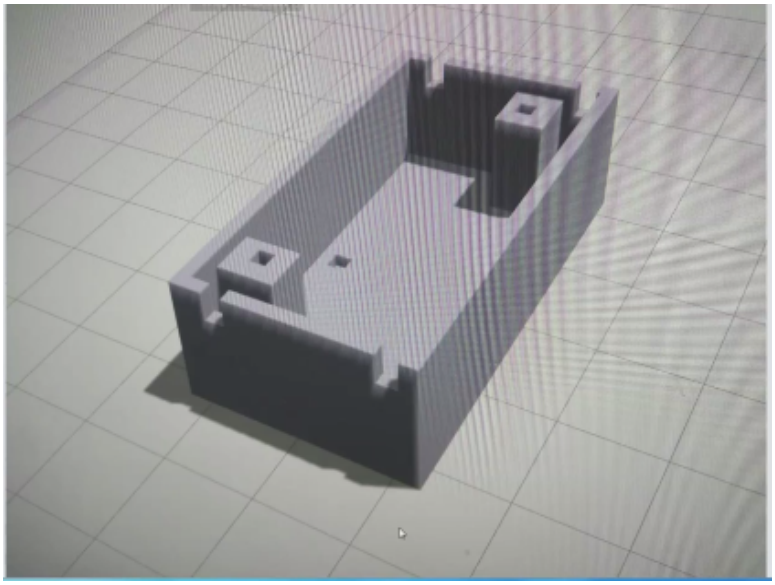

If you use a grey coloured what you call material our job is going to look like this. One of the things you see is we have minimized the amount of movement and made it easier to build and try to reduce the total amount of materials on. In spite of it, it shows some so many grams in the beginning I have shown you, so this one of the jobs. You see here total mass is only 5 grams.

So we have achieved to make a really light product and only problem is because of the what you call amount of finish we are looking for print time is long 1 hour 22 minutes.

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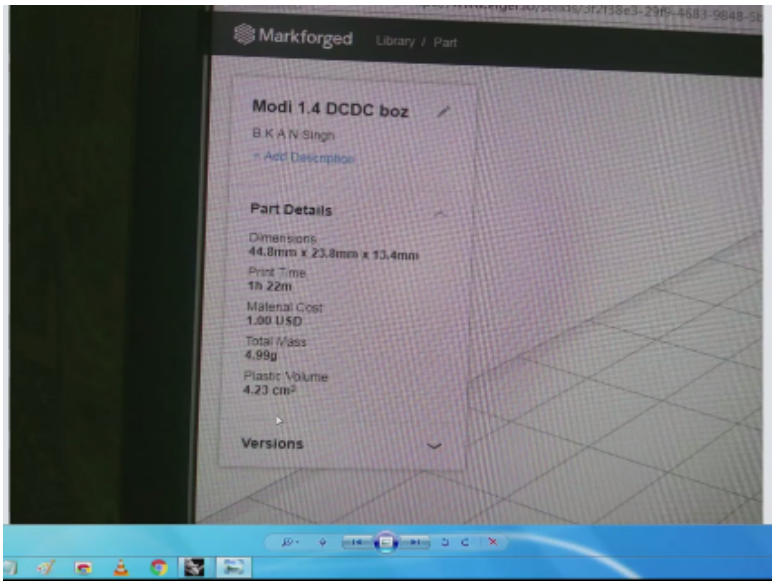

Why because we have given a thin section and then we are using one of the thinner wires to see how well it builds here and other data like what is the plastic volume is given here. So related to this from here the mass is calculated, the dimensions of the object are also calculated. So and this comes to the most important thing. One of the things we need to do in any of the 3D printing what do you call setups is find out where to place the part such that an accurate easy to release piece comes out.

In our case later on in the what you call in the video you will probably notice it we have lead screw at the back and a cantilevered plate which keeps moving up to. For this for support and all that they have given things here.

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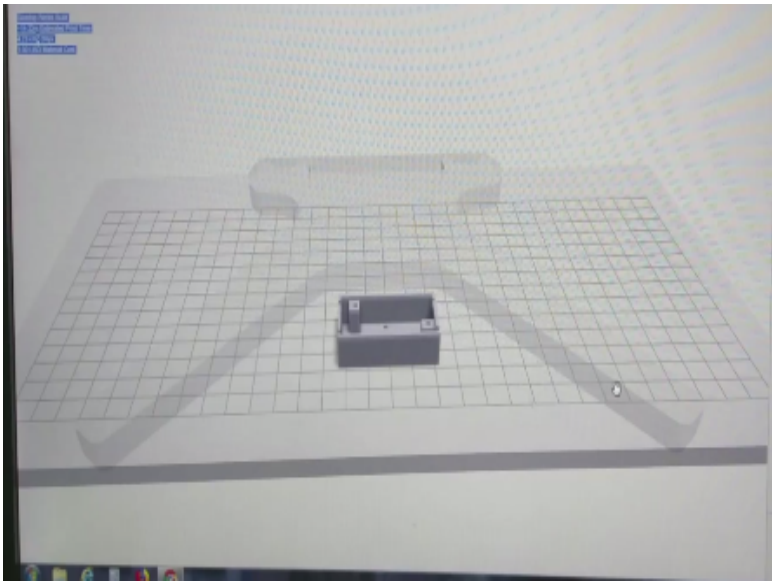

It is very logical because of the type of printing and all that know. You select where you want to put the part. If you keep it too close there is a problem and if you keep it too far away there is always an accuracy problem so by a little bit of practice, we have managed to locate this piece and one more reason is if you want to take multiple prints without disturbing the original location I can now populate it here.

I can go back another 2 more rows here 1, 2 and then this side know one column here, one column so that 9 of them can be printed usefully. If the part is a little bigger we need to print more of them and right now we could not locate that particular command called the step repeat command. Most of the you know packages have that by which if you load one piece you can make it step repeat.

Alternately when you create the drawing itself you copy paste several places. After you copy paste on the several places you upload it. Only disadvantage being the drawing becomes big. Everything becomes all the vectors become you know very, very large, database becomes extremely large. If you have a step repeat function built inside, you need to give a little less what you call only one instance of it can be taken and the whole thing copies itself there.

And the advance programs allow you to manipulate the objects on the screen. So what you carry from one place to the another on a pen drive or send it by mail is going to be small. Later on we decide how we stalk them. Some of the places how we oriented stalk them also makes a small importance.

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Later on when we go back to the what you call to the machine I will try to show you other things. You see here in the other monitor lust like that I went and gave a small picture. A small query here saying 3D printed box for arduino so anything you want, see beautiful arduino boxes are here. You see here this is one of my favourites.

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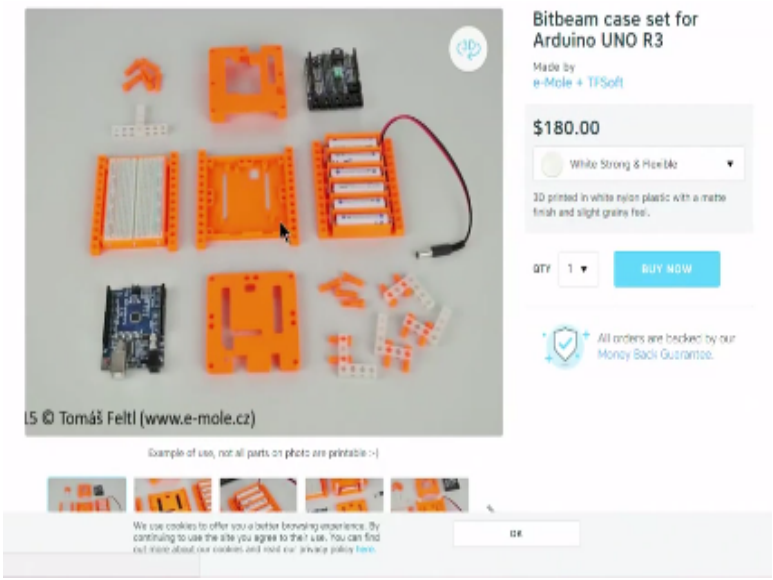

So what is so important about this. The important thing about it is arduino is a developmental kit. So to help in building things around similar to what I have been doing people have gone out of the way and then built very, very useful things. See this here we have the printed circuit board and there is a place for the power supply jack here which is the power supply jack here, expect that this is probably the USB or switch input.

And then you know we have the 2 rows of connectors here and then see something else here at the top, you also have a place for the cell here, battery and you have a cover which takes care of all of it and you have a full-fledged Arduino case set. So you can place all these things inside, this is where you can either buy it or rent it or whatever it is, and what is this, this is a wish board, they have also integrated a wish board into it.

Now if you go down you see here very, very beautiful 3D printed objects are available there. It is possible for you to skate on your arduino board.

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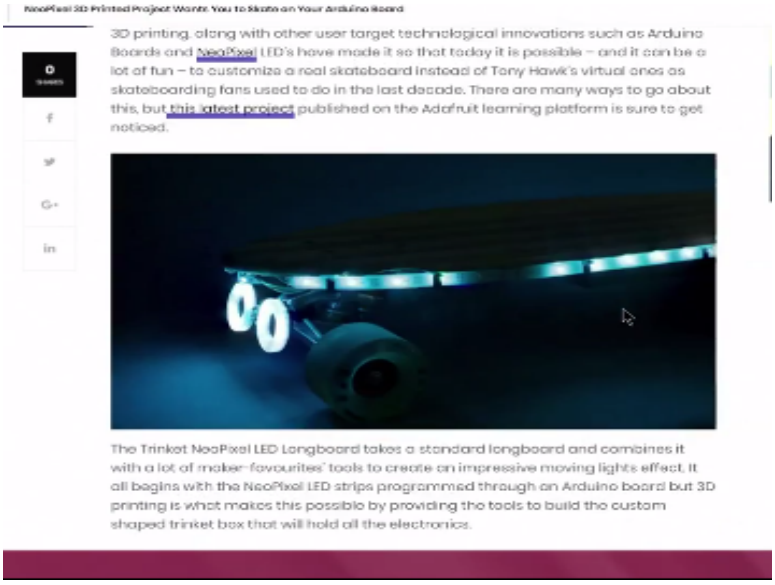

Seen this know, so we have a nice what do you say readymade project enclosures that is you know that is there. So the other green coloured hinge I have shown you is also from this thing give us saying a universe of small things you know. So anything you want know all the stuff is easily available. I am very, very and you see most important is that most of these kit, I mean the source or the things are easily available for you.

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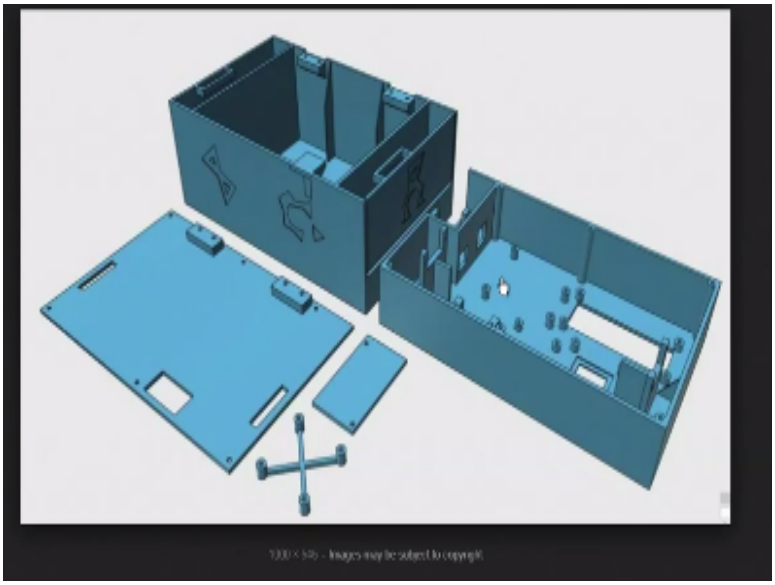

See here complex electronic item can easily be built on your if you have a printer yourself you can print it alternatively you can buy it.

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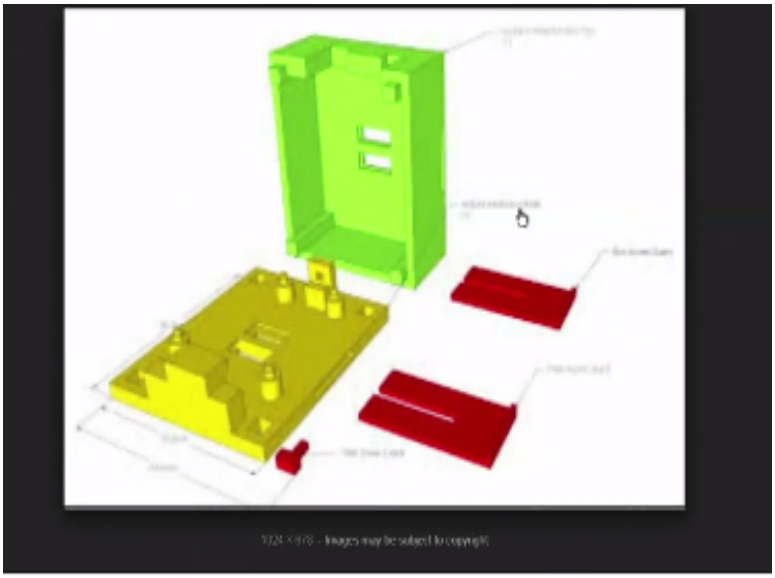

So something here, printable arduino protection box. A few things you will notice here which I am proud that we also parallelly discovered it.

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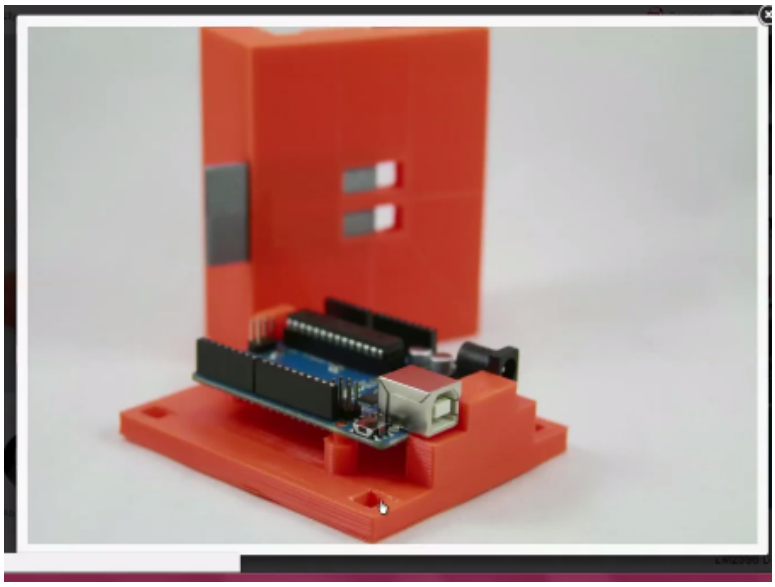

Remember I was talking to you about we should have square I mean openings and so on compared to round openings. In the case of our normal workshop practise it is customary for us to make circular openings, but I the case of 3D printing it is much easier if you come with a square opening because the way that tool travels and it makes things very, very convenient and easy for us.

So I have here an example of whole thing and then if you remember earlier on I was talking to you about the USB this thing. This is probably a type, I am not sure type B or something then you have a power socket and you see here all these things are raised and perhaps the

most important thing here is the way the small thing is sitting here and if I download and if I enlarge it you will probably see, I will try to save the image on to the desktop.

And then go back to the desktop and see this is what I was trying to tell you earlier can you see here, the reality of 3D printing is this layers are visible all the time.

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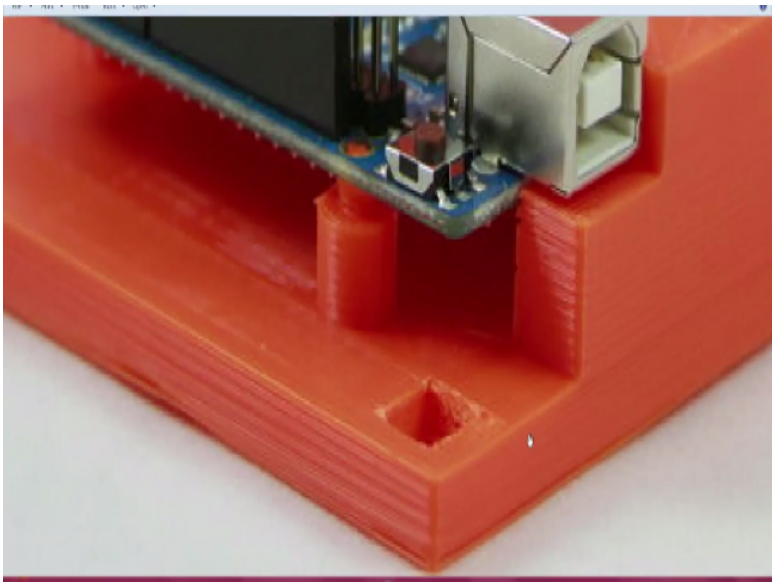

And contrary to what they have been showing you in all the demo parts. Real parts are going to look like this, in fact you have seen here inside there is a very rough surface, but this is reality so functionally it satisfies all your purposes. There is no issue about functionality of this and then later on you need to now decide whether it is sufficient for you or what you want to do with it.

So nonstop really huge amount of data is available. Now have a look at this seen this, this is only the what should I say the 3D solid model that is there not the printed one, what you saw there was the printed one. If you see here everything looks hunky-dory and smooth and so on, but the realities in this corner and then if you see this openings you know we have the problem of there are not smooth as we expected to be.

Same thing about the top cover also. After the top cover sits on this and then you will see here what has been done they have provided 4 small bosses here so that the printed circuit board directly snaps on to these bosses. So you take it here snap the piece to be on to this and directly on top of it you know you snap the other you know thing on top of it and you see a small red coloured something.

They have made a gap here so that you can push it inside, it acts like a door, this top one is for the door on top, this bottom one is for the door at the bottom and I do not know the English word, I do not know if it is called the spigot or something that is useful for locking it. Now going back to the we have a very, very large number or these projects all over the place. It is relatively easy for us to build, make anything.

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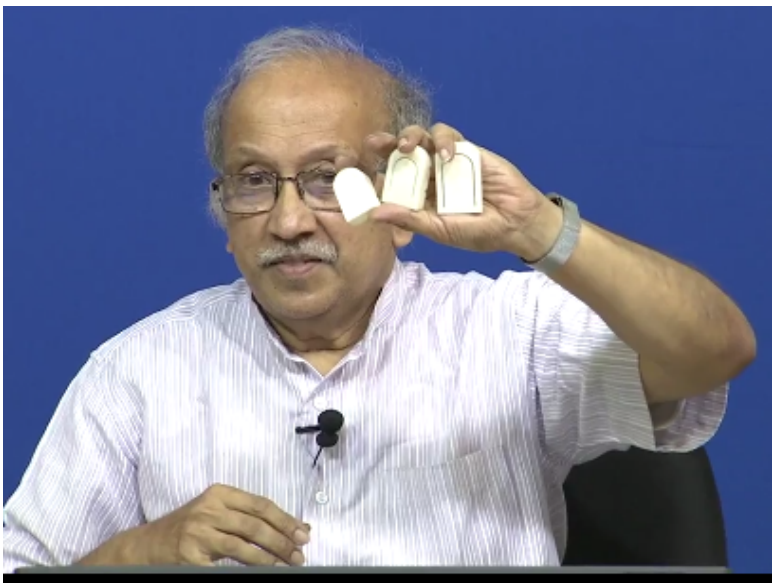

Now kindly see the small sample which I have brought here this one. You see here I have a, see we try to make a small switch like thing can you see here we started with believing what we read everywhere saying will we make it like this. So one of the thing you will notice is there is a gap here, you can see that. So if you want to make a springy layer if you can make a nice overhang.

You see here I will just show you, you see, observe carefully, can you see, this sort of what do you call minor tricks of the trade you need to do. So you can have a springy part. This in turn goes and touches something else inside. So this was supposed to be made for an energy harvesting switch. So we have a completely assembled switch module like this where this is a completely remote device but unlike the other remote devices it does not have a power supply.

I just you know press it a couple of times the charge takes place and so on like this. I am sure a lot of you people must have seen this thumb push for a we call it a doorbell switch. I think Americans call it a thumb push. So one of my colleagues Dr. Prabhakar works on energy

harvesting so this has been made by my colleague for the same purpose here and in fact there is a beautiful movement inside.

There is a spring inside, tremendous amount of detailing has been done and if you carefully I do not know from there whether you can see it or not lot of mechanical and electronic stuff has gone into tit. Eventually we have a completely functional switch. If we put a spring inside you see whole thing moves and this is typically a fully functional 3D printed item.

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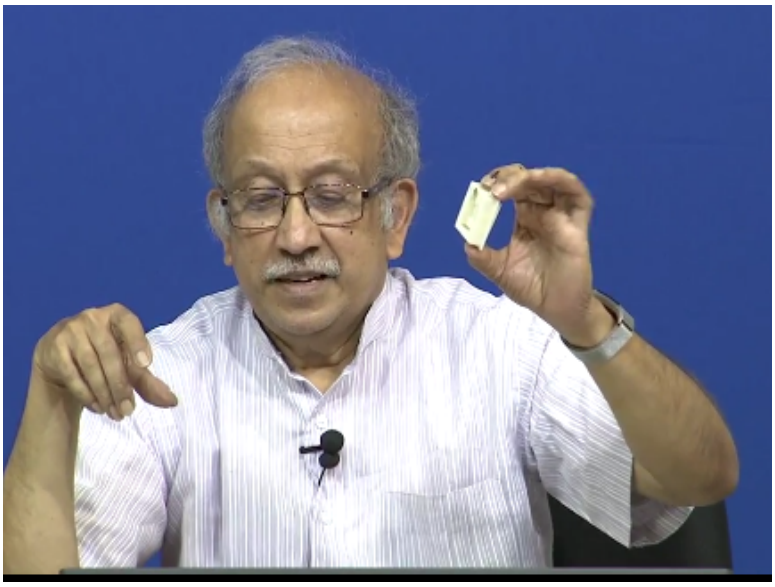

It is nice you need to see it and now if you see these now we come to the other point how do we attach these things to each other so your what you call I will say your guesses as good as mine so in this case, can you see here there is a small circular opening here there are other things and in like a conventional way we just take what you call, take a screw and push it. On the other side you see lot of detailing is there.

This detailing you need to work on by directly on the computer that is when things are really convenient and easy for us. So now you come into some other areas know which I say are little both possible and not possible with our this type of a design. See in this here. I will see if I can press and actually it goes and opens that, it does open that, now first shot we may not be able to make this in transparent materials.

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Building in transparent material is tough; however, something which is related to this 3D printing is the laser cutting. We have as part of this if the machine is ready we can show you the laser cutting also. Here what is done is flat acrylic sheets are taken and they are cut using laser and then when you assemble the whole thing we have a beautiful thing, what you call beautiful functional enclosure.

Only thing is sometimes acrylic is useful, sometimes you do not want things to be seen inside. So wherever something is flat and absolutely there are no you know undulations and no detailing like that I show inside probably this is best for a full 3D printing exercise. All the windows and all that you probably need to separately to make like which happens to this here.

If you see this beautiful device here the whole thing can be printed without any problem except the small window probably you need to insert either a glass or this is simple moulded acrylic thing.

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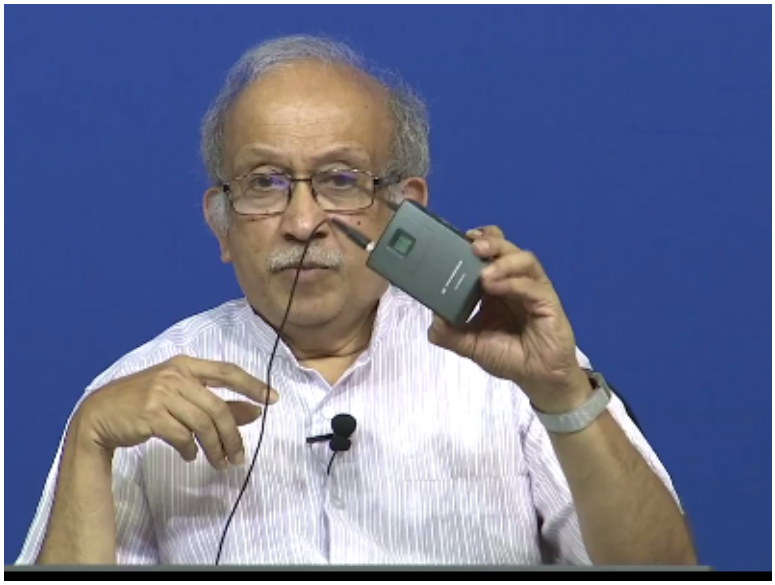

And now the good news is even transparent materials can be easily 3D printed. So this is one of those things and having come so far why should we restrict ourselves to only simple shapes. So somebody has built a beautiful, nice, you see here.

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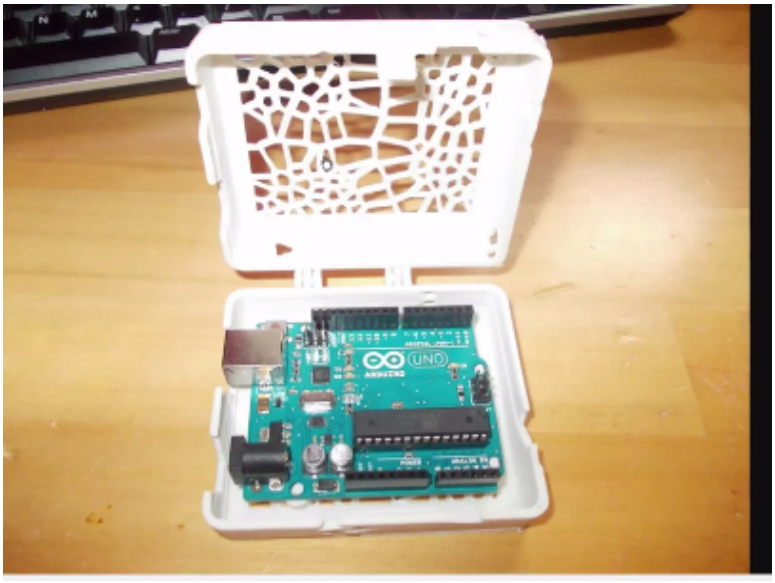

They have tried to play as much as they want with an attractive pattern on top of it. So now you go back to architecture now if you go back to anything including product design and including our apparel design including anything basic functionality is one. The element of aesthetics and the element of novelty also makes a lot of useful proposition and variation in design. So they have built that little bit of novelty.

And things like this are very easy to build with a rapid prototyping device. So it is nice to see and that being where it is, you see we have a nice simple enclosure for RF and anything we want.

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There is a place here probably it is a what you call MCX connector and without worrying too much about optimization probably they have directly taken something which is similar to what we have in the injection moulded devices. So in case you have an injection moulded device that is what I showed you with this is taken directly from an electrical switch gear, house wiring.

And after having you know modified in everything and all that vastly improved directly printed thing has been made, this is you know as part of another project I thought you know I will show you, you have seen this know, is exactly what this picture shows here. This picture what it shows is they have taken an existing 3D what you call, injection moulded part and then they have tried their best to do something else with it. Now if you see here;

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