Electronics Equipment Integration and Prototype Building

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Lecture – 02
Examples from real life Parts to system

Hello, let me continue where I left off yesterday.

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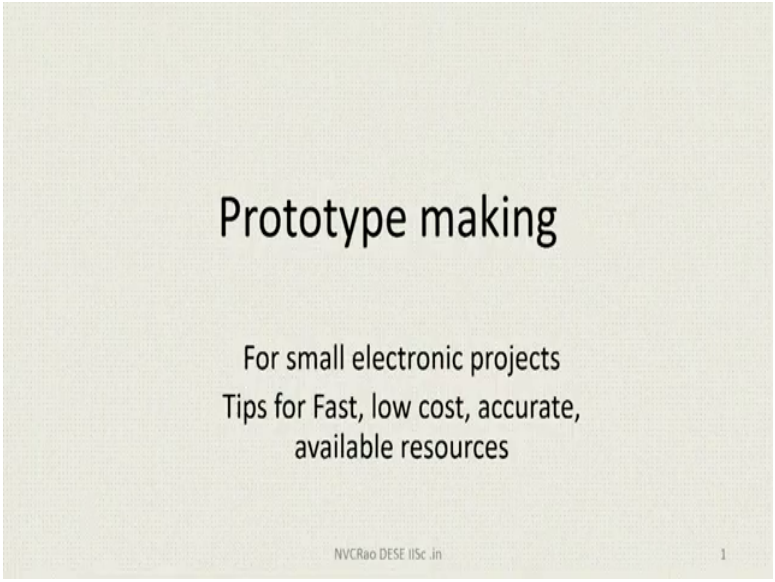

So, you will see here, we started in this prototype making and then I took you all the way and probably that is just a recap of what I had covered a little yesterday.

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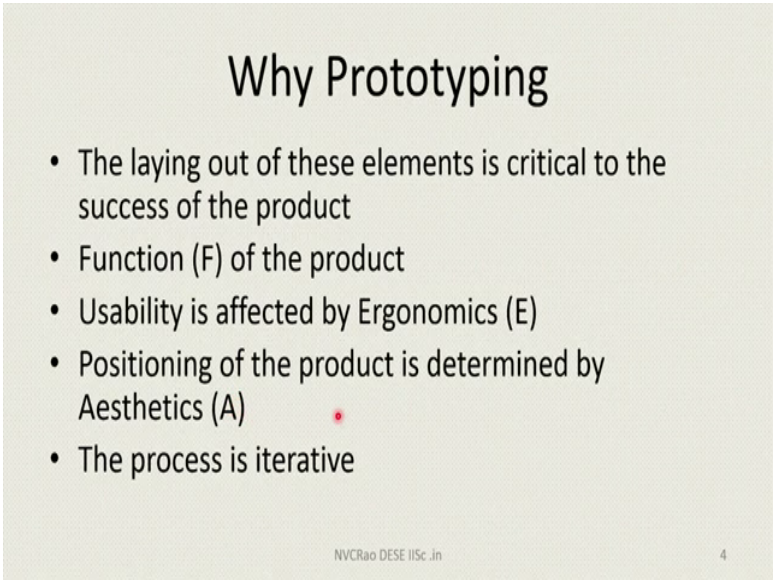

First few minutes, I will take it. Why do we need prototyping? We need prototyping because we have to find out how the product functions, then something related to usability, positioning of the product in the mind of the public or the intended user and it is a iterative process.

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After you keep trying again and again, a value eventually you come to it.

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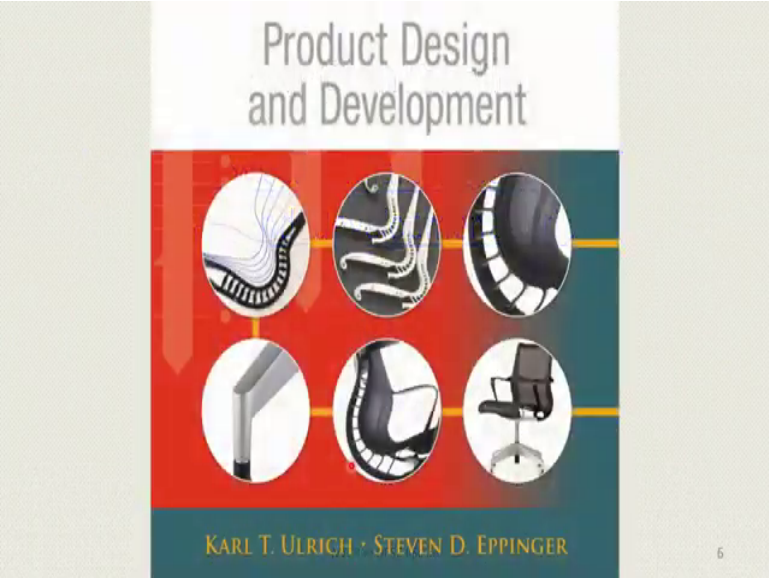

Then I have said you need to buy and read the book and even if you do not have the current edition whatever you have access to in your college library or anything, you can please try.

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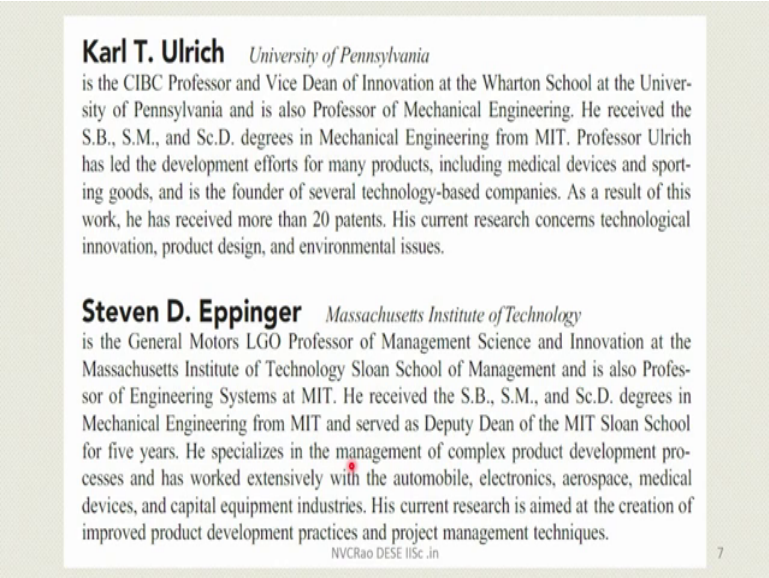

And then I have also covered who these two professors are. So, then I think I should tell you something more. You see this he a professor of management science and also their Wharton School at the University of Pennsylvania and you will notice that product design is not just design of the unit as such it has a lot to do with product management.

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So, now I will go to the other thing, then I covered all this saying know out of this we are only interested in design for prototyping.

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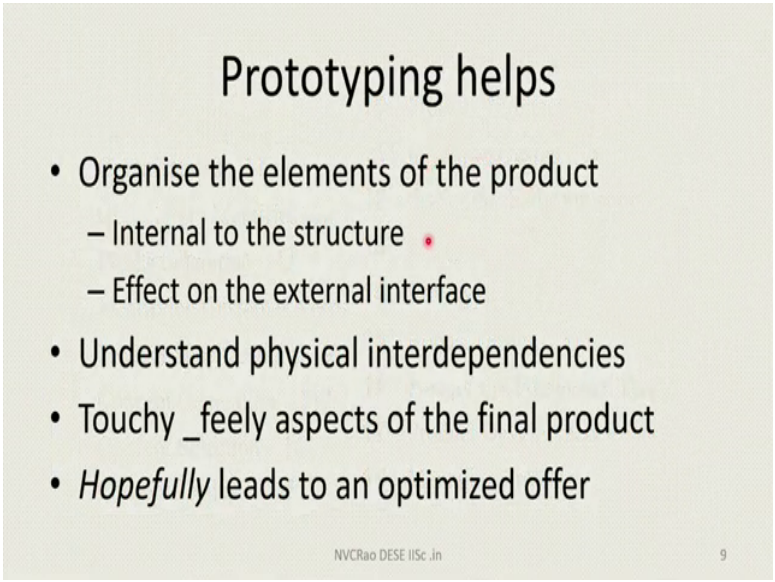

Then organize the elements internal structure physical interdependencies hopefully lead to and so on.

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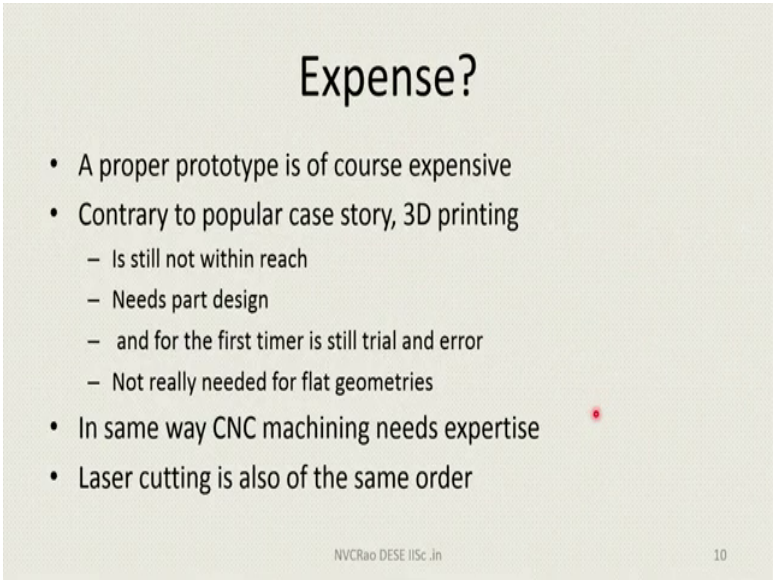

And then I have also told you about it is not within easy reach, CNC machining is also tough.

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All you need to actually require is probably some free downloadable software and local laser printer make printouts on normal resolution paper.

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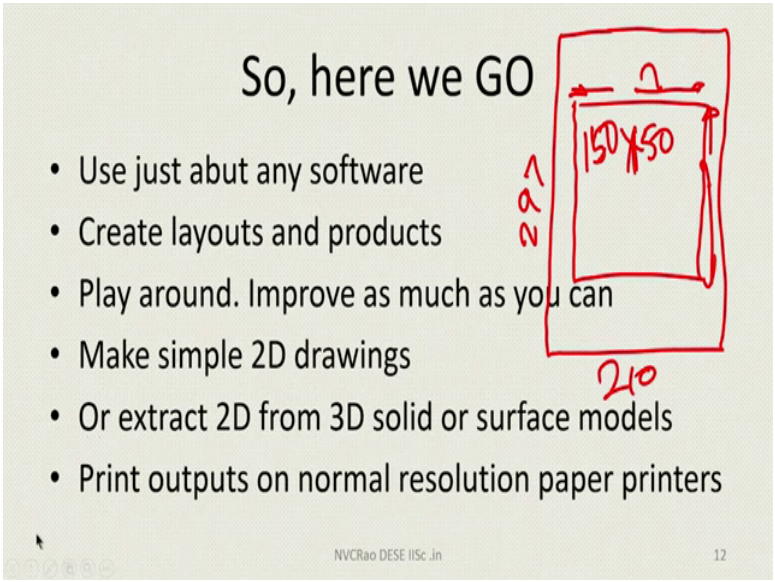

From here, I will try to stress a little more on this thing. We have an intension of keeping everything to a proper scale. Often very inexpensive printers and we have been used a little longer have a tendency to lose their calibration. To keep the calibration working, one is you should try to calibrate in case there is a calibration mode. In case there is no calibration mode, you need to print a small square a grid.

Typically, if you are using an A4 printer, a minimum of 200 by 285 millimeters is available for printing; 200 by 285 because the normal thing is 210 by 297. I have removed 10 millimeters and 6 and 4 on the left hand side and for the longer edge 297 for the longer edge 297, you will notice that because of the various paper feed and all that more and less margin is lost in that.

So, you need to print a non physical what you call figure two figures are commonly used. One of the very easy and good thing is to print a square. Print a square such that it is known dimensions. Typically since the width is about this is so, minimum of around 200, we will get and up also; know about 290 we should get. So, out of this the best, we can manage is if you print 150 by 150 square and finally, check the distance.

What is the distance from here to here? Take a ruler, check the this thing that is the simplest way of calibration. Now the next way of another way of calibrating this is instead of a simple square, is it possible for us to print a grid? So, my favorite has always been make a grid of 20 mm grid or if you are a little more familiar with inches typically your digit is 25 millimeters that is approximately equal to an inch.

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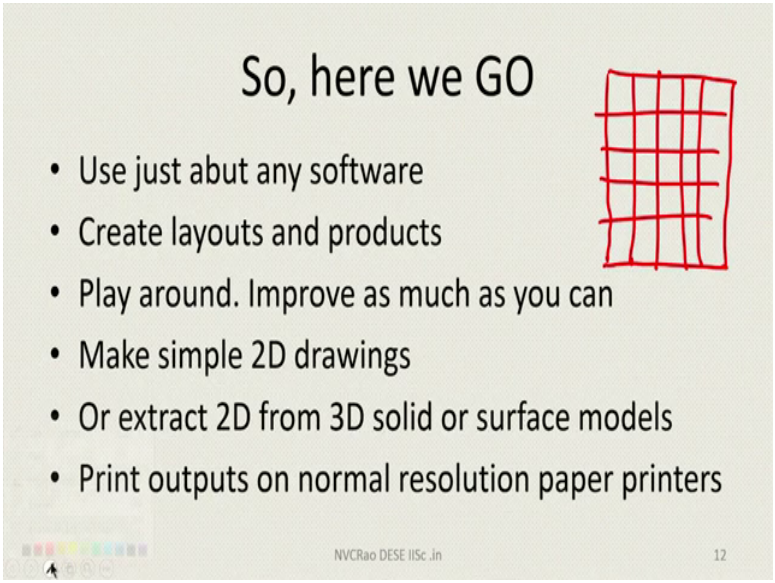

So, make something which you can split into equal parts make a grid. So, 25 mm we can get 6 of them. So, if you make a 6 by 6, 36 thing. So, you get a 150 mm thing, then in that case you can see besides the total dimensions is there any distortion in the middle also seen that know beside, the overall width of the dimensions.

One of the important thing is to calibrate your plotter and the earlier you do the better it is and then again a little related to this instead of the grid, it is probably depending on your perception and so on if you are a good artist.

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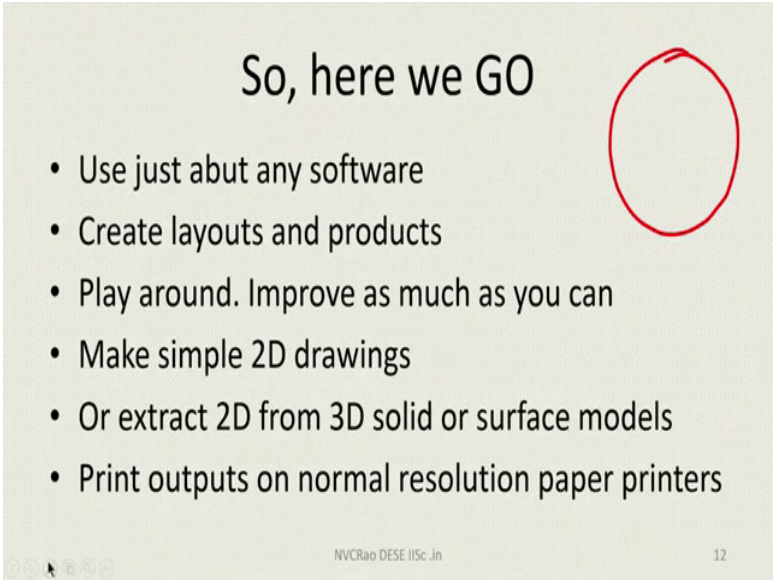

It is probably much easier to do make a circle and only problem with the this approach with the circle is we cannot easily measure how well there is any distortion. So, that is that covers

about how to calibrate the printer because the important thing is normal resolution paper and this printer is very very critical.

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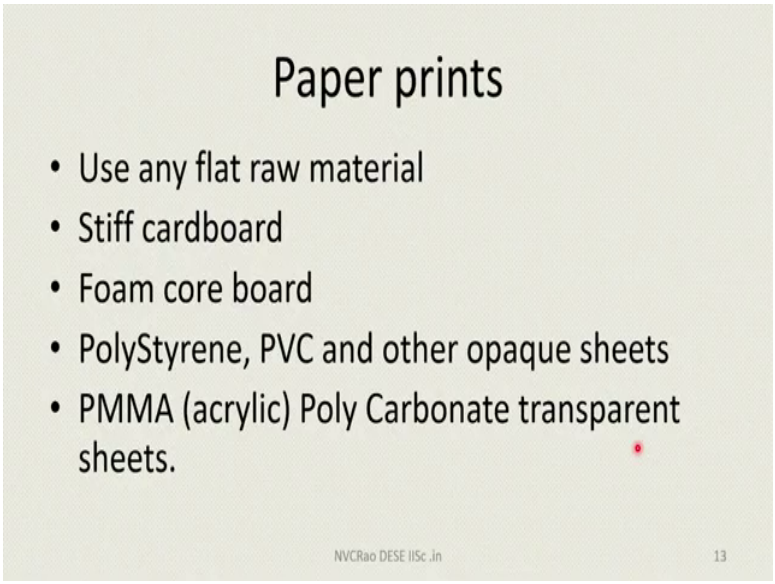

Next come to the other thing saying. If this print that paper what you have can be stuck on to, you have a transparent or a white colored paper. You can now directly paste it on any material.

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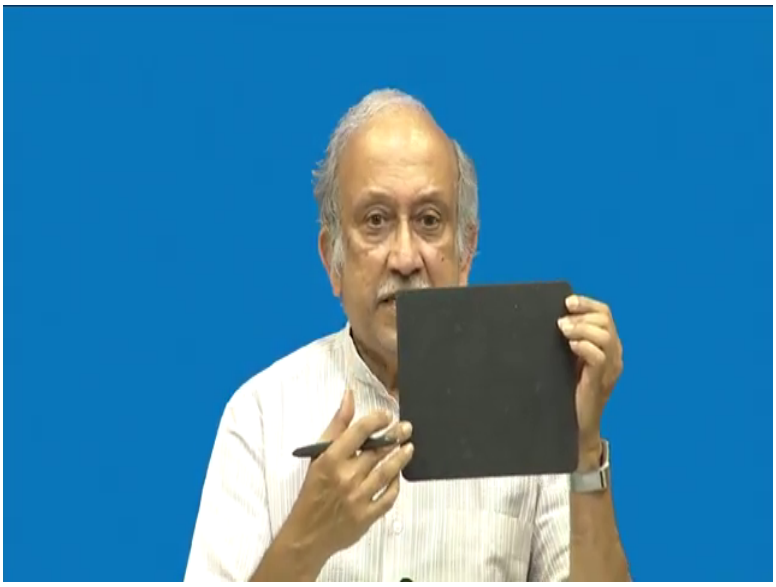

I will just take this for example, I have this mouse pad. If I can paste it on to this; if it is a self-adhesive it is better, but if you do not have self-adhesive use any what you call paper adhesive like any hobby people use the adhesive. Stick it on this. Now you have a simple way of directly fabricating beautiful shapes.

Foam core, advantages it has a thickness, then polystyrene PVC and other opaque sheets have been traditionally used by industrial design model makers to make very very impressive items. And why do I say PVC and polystyrene is after attaching the corners and making them firm, you can always use your skill in sculpting the items.

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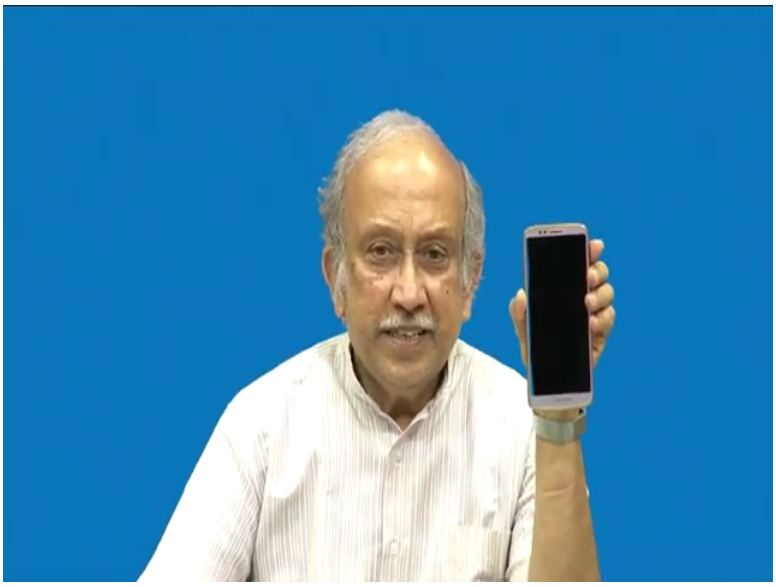

So, if something were let us say we have something, you can probably start with a flat object. After having started with a flat object ok; after having started with the flat object, we can now round off the edges you can round off the corners, we can add features, we can do everything. But mind you we did not use any high tech not easily locally available technique. All we have used is just using our printer stuck it on these things. Now we have two other things, one is these are all transparent shades.

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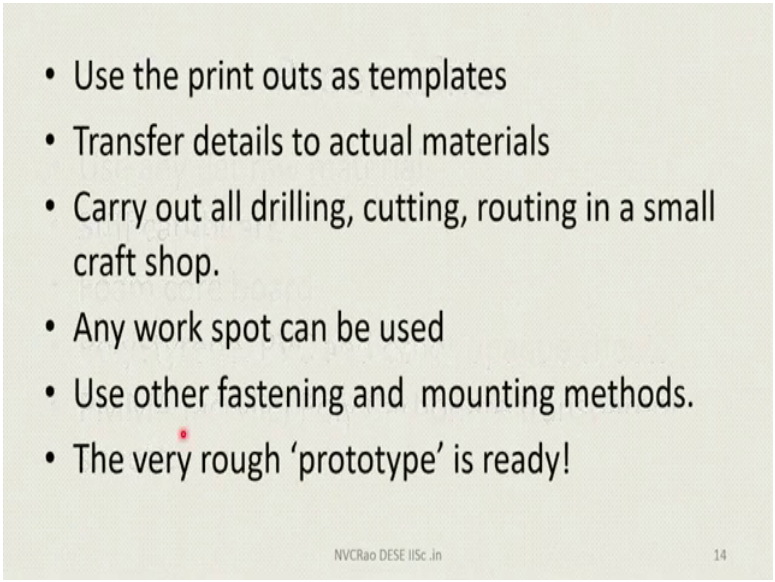

Use the printout as template. Again recapitulating transfer to materials. Cut out the drilling, cutting, routing in a small craft shop, any work spot other fastening and very rough prototype is ready.

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Now from here, I will go to this presentation which is made by Matthew Kressy. He also now if you now check for their credentials, you will notice that they have now moved on to next level of product design and so on.

This directly this has been downloaded as part of the MIT OCR OCW, I am sorry and I expect that all of you know should acknowledge it, do not go through the remaining presentation without the title sheet. I will quickly go through what is all this user experience everything know, I leave everything as it is.

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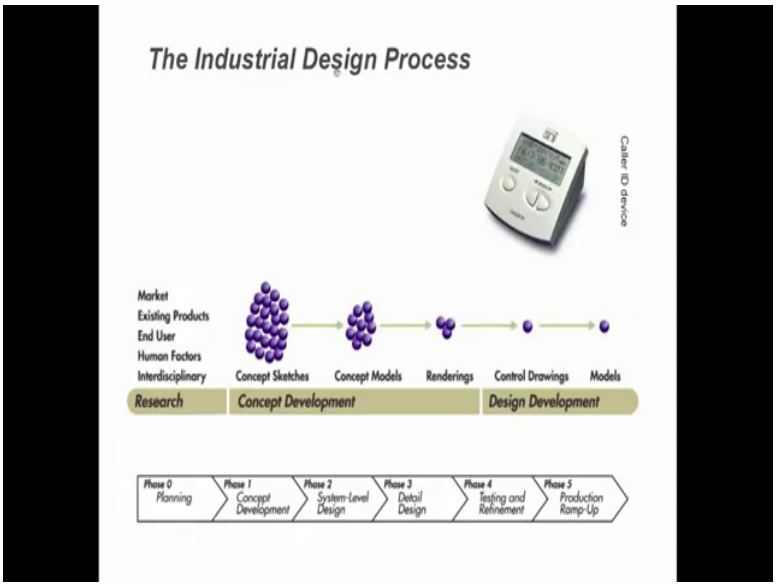

I will come to the most important aspect. The design process though here this is the industrial design process invariably comes to all this things making models and eventually this.

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Now, you see here. Can you see here? We have a large number of items one of the important you have seen, you started with saying reverse engineer the existing units.

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Now, when you go here, you have dealt with all the other things.

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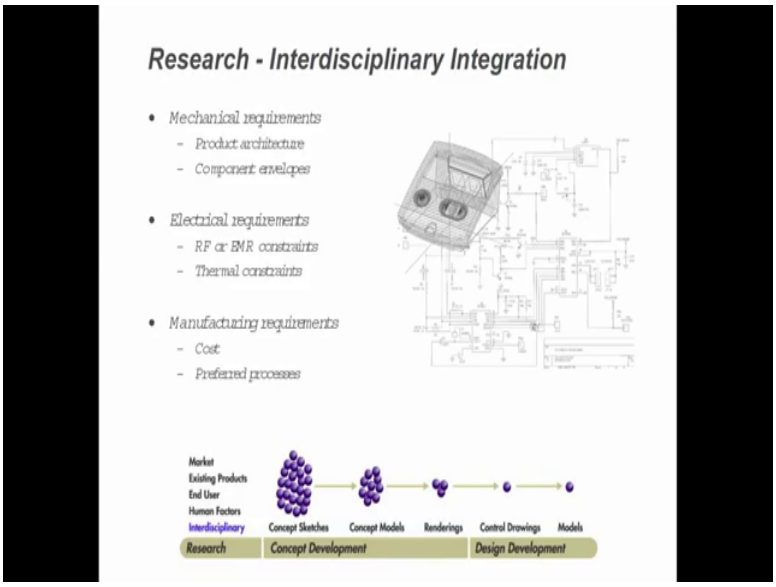

Two important things are there. This is what I had cover tried to cover earlier saying for most electronics people, this is easy. It is susceptible to analysis plus you have application notes for each of these circuits. However, when we come to putting them all into physical form not yet fully ready and here things called electromagnetic interference and thermal interference are at best a specialist job though most software permits you. So, then we come to the cost and preferential which I shall not cover here.

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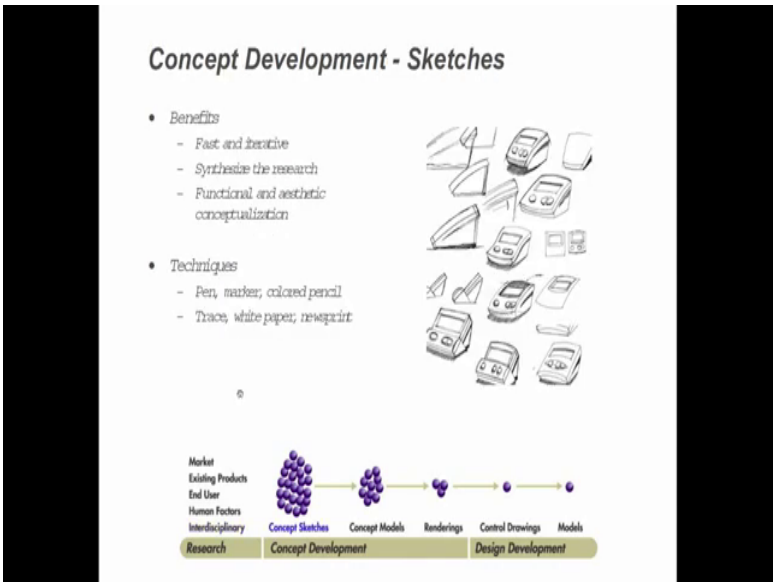

Now, you will see here. First thing what we need to do is you need to have a sketch. If you can manage it using a sketch a computer, its fine; otherwise you still cannot beat a paper napkin and discuss it with your friends.

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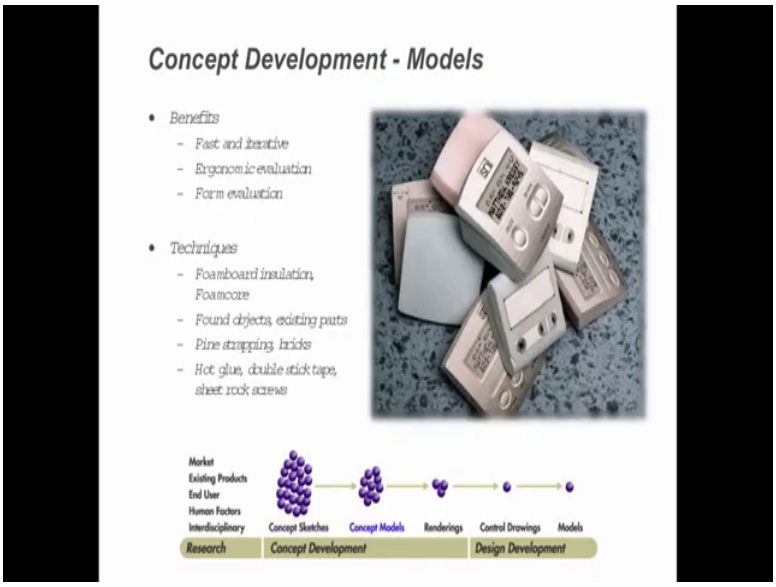

We come to very interesting thing which I am talking about models. Can you notice here? This is very difficult to make out, is it actually a product or it just a rendering or what it is, but here you clearly know that it is just a cardboard model. You have seen this and these things are a little difficult to make out what these are. So, we come to that is what I told you foam board is foam core this thing, then any objects. Can you see, can you guess what it is? This is probably apple the type people swallow or it could be can knob from another some other product.

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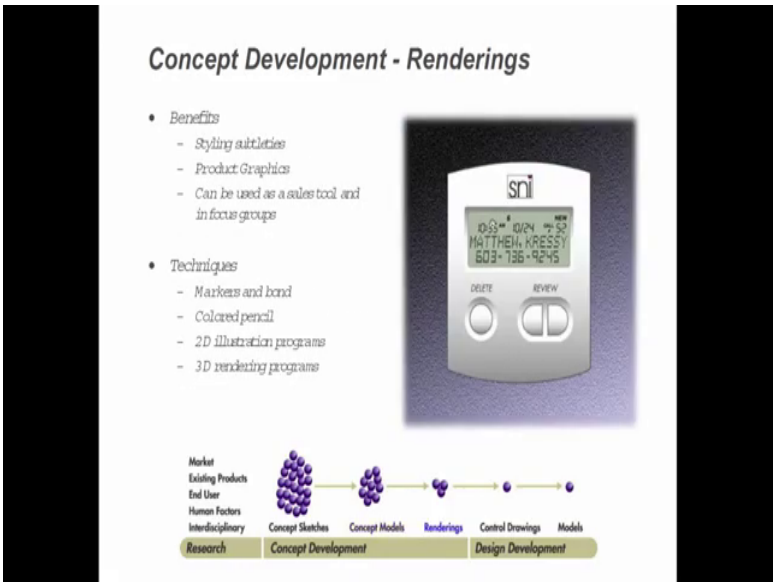

So, use all these things and make this. Now I will come to an important thing here you have noticed it; obviously, this whole thing is a rendering not necessarily manufactured product. Why it is? You see if you see these gaps and you see these highlights and all that you know.

If you are familiar with regular rendering a railway station software, you can use it. If you are not familiar with it, you can just print the outline and as a piece of paper and try to share it and render it. This is good enough at this point. I would like to say most likely very rarely, you work alone. You always have friends, you have other people who will help and depending in your lifestyle know, I am sure a lot of friends will help you in making this rendering you have seen this.

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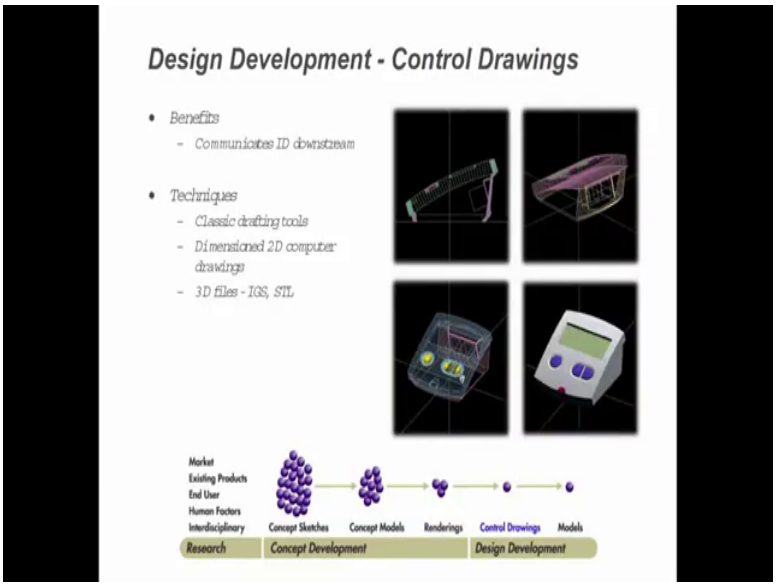

Now, this is where that new this thing know has come saying most important is any concept you have we need to convince other people in your team. So, if you are in team, you must make this. This full thing is just a rendering on a computer, it is a wireframe model. And from the wireframe model, you have all this and finally, this is a rendered object on a computer.

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Now, we come to the important thing saying how do we convert that rendered model into these things. Now suddenly you will notice from outside, we have entered the inside of the product what we want. This is a fully integrated product in which even the keys are part of the case. Similarly all other features which hold together, the subsystems are already in place.

And for the first iteration, you do not need to go and if you want to actually get this 3D printed, this is a probably a injection modelled part. This is the first cut 3D printed part. So, they have just kept both of them together and done it. It is tough, I will not advise that you know you attempt that 3D printing because it is a tough absolutely tough. I will close this. Now get back to my presentation, seen this here we are here.

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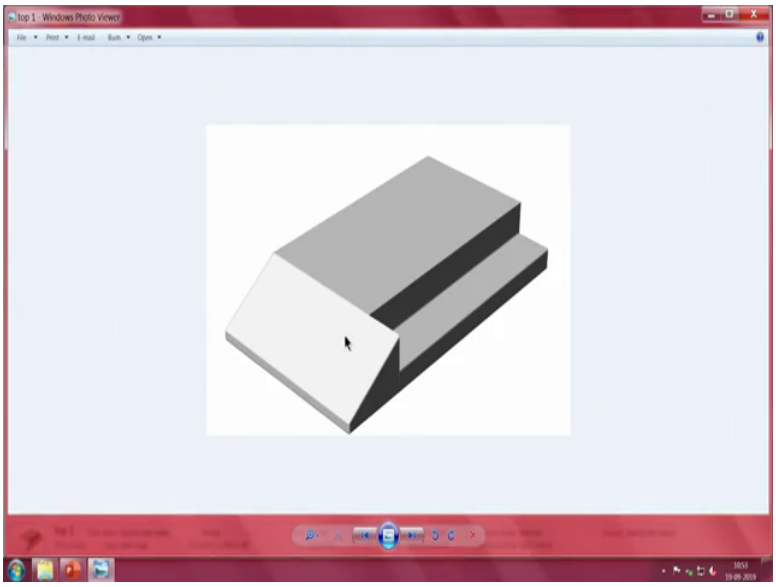

Now, I will try to show you for the end of the first thing where to what does it look like? Though it is a rendering first time, you will notice is probably this whole thing has been made out of cardboards. And why do you need this is? You need to find out at what angle, it is convenient. The more you tilt, difficult it is the more its vertical; it is somewhere you have a compromise.

So, now you have a flat area to decide what to do with it. Separately you can deal with this and make a control panel. In the control panel, you have the various items saying what goes where and some usual bloomers, we do where we what we call put things wrong way. Now you see here intentionally only in the rendering this radius has been made to show that there is a step here

Now, you will see the next you have seen this. There is a step underneath, then there is a step here. Now why all this has been done? This is to ensure that it sits comfortably in a hand seen this know and there is a further functional use for these parts also. So, I will go on to the next pictures. If I turn it over, you see what I have there. So, I can use it for probably taking cables out or making a rest seen this.

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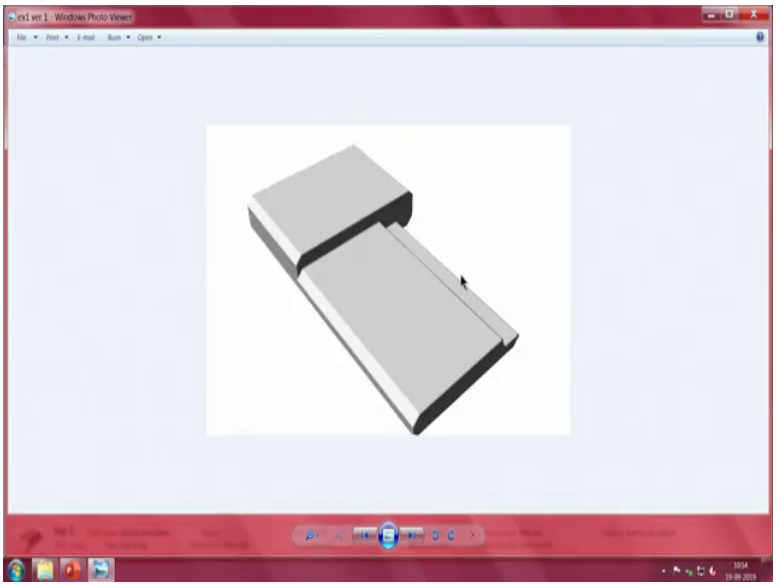

While so far this has been a very simple thing now, we have come to a very very interesting thing. This is probably a handheld meter of some sort. Now coming back again to this bottom this things, you will notice that somebody can hold it comfortably in the hand.

Now comes the question is it the bottom or the top am I seeing the wrong way you have seen here. Now all these things know have been added. Now if you were to start with a PVC which is cut as per your template, you can always attach this thing same thing with polystyrene

sheets also. You can attach make everything round off the corners and you have a perfectly working model. This is a scale plan view.

So, in this plan view clearly, you can see if you have printed it to scale and your printer has been calibrated there saying you start with a some comfortable thing. It is possible for us to now take parts of this and directly stick it and in that illustrator package; if I can also print a front panel, I can probably stick it on this or use it directly.

So, two portions one is use it as a template when you have an outline, then after cutting sticking and assemble it together, you can use it directly as a template for that. You have seen this, now you see this side view. Now you see the other side view this whole thing.

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This is going to be your first what you call all project prototype which you can think of and very easy if you see carefully. Though it is all made out of plastic and all that its more out of convenience, you have tried to make it out of plastic. And you see the graphics, you will see the type of display, all these things is very easy for you to simulate in a color printout. In case you do not have color print out, you can always make this.

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So, I had just given saying have a look at all these things. Now you see this. You have the choice, now you can now decide what you will put where, how do you make all these things it is a very useful thing. The way of organizing all this know is generally goes under the name of control panel organization.

Even if you were to make something in rapid prototyping either CNC or anything eventually this whole thing is going to be probably a sticker or we call it you know a layup sheet which

is kept on top of it. You have seen this very interesting thing fork is in a diamond shape which is what most instruments will have.

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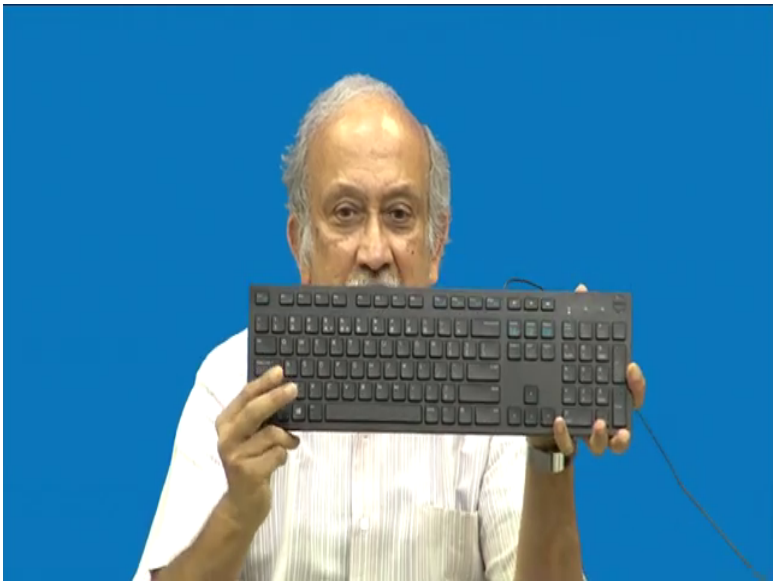

But then you look at the keyboard all of us have not a nice way of making this four keys. If it is in a simple matrix type of thing, you will notice that it is not very comfortable to operate this case. Instead the same 4 keys have been put in a more logical diamond shape in the that control panel thing which I have shown you can see.

In same case, but they have been put here and then something else have you noticed critical thing like this power on off switches then various other things you know have all been played around with it. This whole thing really does not require that much of a.

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Now, you take care of a what looks like is probably a high end what you call digital device and in the case it is also a oscilloscope. Now we will see here while the right side you have all these features and all that. The main thing which is we can put here can probably be simulated in cardboard. And even here if you see; if you see the construction and all that know, this is probably just a ruggedized case which takes care of these things.

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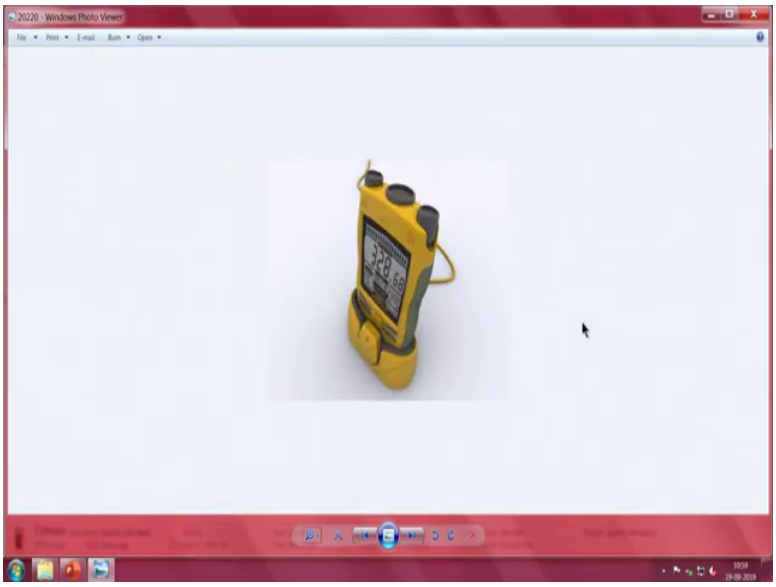

These are cannot be easily simulated in the method which I have told you this is probably some this thing.

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But see this now, your next exercise I suggest you take the case of a simple handheld meter make it at home make it with your available resources and try how the good things are going to be. You do not need all this, you do not need all this what we call grips. Similarly we do not need all this, but; however, it is not impossible to make this I will show a sample which my students have done.

You can in fact, probably make a cuboid the height is approximately just enough to take a couple of torch cells and then this you can use any materials lying around and even if the boxer to be a box a breadboard like thing, you take a sticker and put it on this; definitely it is going to look better.

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I have a picture of that. I will show you see this you have seen this even if you had to have a box which is straight or even its a little angled like this the moment, you attach it to that including this rendered image on top of it you have your sample product ready. That is a good way of starting with low cost this thing. And why do you need it?You probably need to show it you other team members are working with you and I do not expect that all of you need to be experts on that this.

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However, really involves next level of thing. I feel in the first stage in the simple cardboard you need not attempt it, but this is not impossible. If you were to have any foam core or in the case of industrial design people typically use special type of acrylic foam, they seem to be able to do this sculpting and they seem to able to do all these things including place for your thumbs.

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But typically I will use a word which is not good a very low cost multi meter is all that it has to look and if you buy one probably, you can get one for I expect 5 dollars or 10 dollars in US dollars. And in India these are available for around 400 rupees typically it will come to the equivalent of that around 5 dollars. You can take out all the parts and switch everything, put it in the new enclosure which you like to make. So, we have all this beautiful things.

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Now, you see here. Generically it has probably a same measurement device except it is measuring soil pH by having a soil probe, then its measuring combo meter that is several of these things are attached together or simple pH meter for you to check around in your labs and so on.

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Now we have noticed not impossible very simple; everything is adjusted by this auto ranging here instead you have fixed ranges. This sort of features can easily be brought out when you make a simple model using native simple techniques.

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Remember the first slide which I showed you. What were diamonds there? Suddenly it has it looks like a jog wheel or regular that stick. These can easily be made by our normal thing. Now we come to this other thing things like this probes, things like that handle and all that no you can attach it to them. Simple noticed again our core of it is this and even if you are to make a simple rectangular box.

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And one of the sides, you attach this and you have a demonstrable model which you can show people.

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Two variants the keys are about the same, but you see the clever use of graphics by which you can emphasize your product. And secondly, there is a physical feature here there is a relief here and it is attached to this by just adding one more thickness of a your raw material, you can make all this very very easy.

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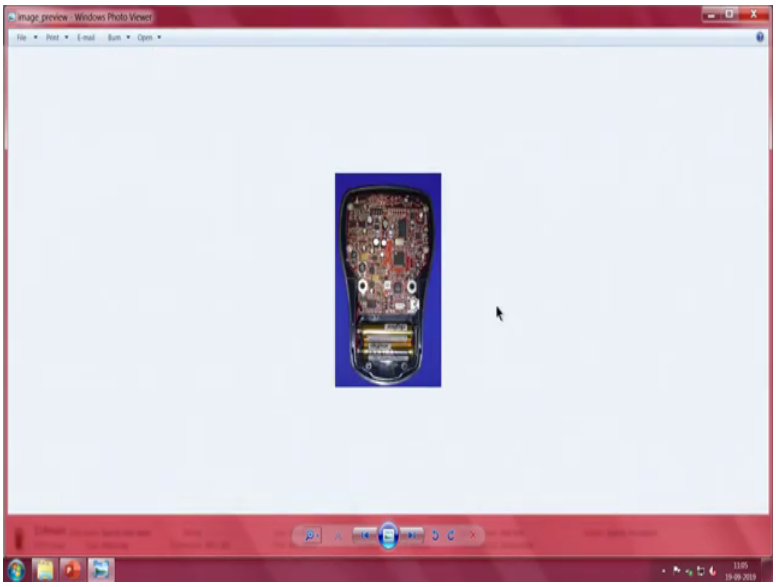

Now, I will come to the little more next advanced or important stage, you will see here that when you start your project, I am sure either you have some idea of the printed wiring board which I have mentioned earlier and including there are cells here meant for the power supply. You do not even probably need the printed wiring board.

If you are an electronics engineer, you know how it looks like and in a real product very rarely a printed wiring board will have a rectangular shape which is identical to your screen monitor. If you are fortunate or unfortunate enough to have a 16 by 9 monitor, you will end up with a 16 by 9 aspect pcb.

If you are having an old 3 by 5 monitor, you end up with the 3 by 4 monitor, you end up with it. But in real life situations very rarely this printed wiring boards have the shape of your

monitor. But if you have to make the first prototype which I told you if you had to make these prototypes, now it is possible for you to make them fit saying I have this dimensions.

So, as I said when I said iterative, you probably must start with a rectangular PWD by which you have a schematic capture, then you have a racks nest, then you have some layout and all that at that stage you can import the first draft what you have made by way of a dxa file into most of the schematic capture or layout software and get this going.

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So, I am just showing you this saying, you have a look at it.

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Now, you see this here this looks simple, even in our cardboard model two or three enhancements have been made you see. One of the first enhancement is that you add the probes to that. So, that the probes can be attached to that. Next enhancement is you have a very accurate digital numerical number plus you have generally a analog meter at the back which shows the trend, the rate at which things are changing and where we are in the full scale which is not easy in this.

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So, I expect that there is going to be tremendous enhancements on your product. Compared to this, this has all the small enhancements which this is the traditional thing except even here you have seen there is I do not know it is a hold button or on off button and there is something here and there is this gentle shape here and suddenly you will notice that yellow case outside is probably a ruggedizing case which gives you.

So, called three I mean 360 degree protection and your core thing is still here and then even here you have seen there are color indications of what is the function and small interest enhancing feature.

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And if we can simplify a whole product into this nothing like it and if you see here clearly, this is probably just a rectangular unit and then there is a key what you call pad which is you know stuck on it. And this is again once again I am not sure if it is a real product or a model it looks a little like the if you go to the electronic shops often they have dummy models inside they do not have anything, but they have this display which already appears lighted up. It is nothing, but a transparent decal which is pasted on top of it.

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You can even play around with this why should they have a flat, why cannot they have a hinge and two parts and in our case we can probably make two of them one of them in this angled form, one of them in the flat form.

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And by just you can have analog you can have a digital; anything you want is easily manageable here.

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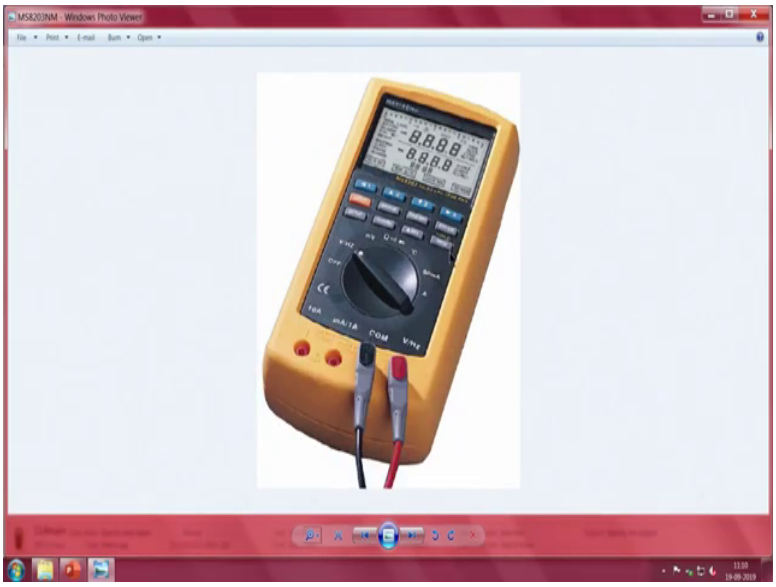

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You have seen the next level. Now, instead of having a knob they have a shuttle or jog wheel type of device which is printed on that.

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This is a next level of waterproof casing. So, let us say you have to make something which follows an IP 55 type of enclosure. You can always get one from outside. So, this IP 55 IP 56 IP66 all the way up to 67 standard electronic enclosures are available. Having got one of those things, now you can organize all your things inside including this is probably a power supply then you have various other things devices.

And then this is where your intended unit can be made at this point that is where I would like to make saying nowhere have used any expensive manufacturing process seen this. This could still be something which is available from you and this could still be tubes. Anything which you know you have got access to and wiring and then a unit or even this also can be simulated out of cardboard much better things.

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Seen this here what otherwise would have become a very simple thing still element of interest has been added by just attaching a few things here and there. So, at this point I will now quit this and I will try to show you.

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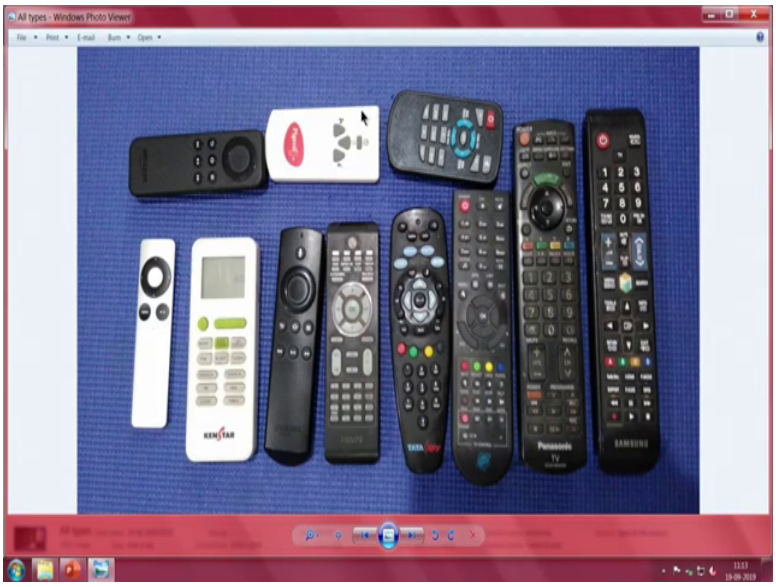

I am sure most of us have faced this problem; too many of these I do not know what you call it devices which control our life. It is not the other, I do not remotely control them. It looks like they seem to control my life. Too many of them I do not even know what they are and then I just found them around and I brought them here vaguely I can make out this is probably from a air conditioner and this is some fan or something and then we have various other things here.

What you notice in some of them is most of them once again have some sort of a display, then you have keys and you have this. And then what about this? And what are all these things? Maybe the next picture will clarify a little two of them taken from two television sets flat things and whether you like it or not. I am sure it has happened to also this whole bunch of this case are redundant.

There of no use or any consequence for us. We do not know what to do with them why they are sitting on this TV. We do not know we also have this case like that and if by mistake you press one of them, you are likely to lose the feed and then once again no you have this jog wheel.

And then you have something now when you were to make a new set, I am sure it will help if you can just make a small thing. Just like we have all these are supposed to be there, again in a set top box we again have all these things. We have so many of them and there is a button know, which says would you like to operate this or anything and they keep changing all the time.

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So, called universal programmable remote and so, within a being un programmable remote and these are from audio thing. There is some quite a few of your must be having it and I am

sure two variants of the fire stick and the lucky people among you would have seen the apple TV. And like all good things in life no know Apple TV, does not believe like you know the Phillips player, it just has the least number of case and it still works. So, making this using a scaled cardboard is very very easy.

I stop here and next week meanwhile what I want you to do is take a look around and take one object one anything, you would like to simulate at home. I am looking for a kitchen gadget which can control everything in the kitchen. I am sure most of us have a hob and if not we have a chimney which takes the air and then you have buttons there and you may have an exhaust fan stuck in one corner of the kitchen plus you have the microwave plus you probably have an oven and then in our case we frequently use these blenders.

So, is it possible for you to have one remote which controls everything in the kitchen which has such way not have as yet no from safety point of view and so, on that are not have any remote control for the time also of that point. But is it still possible for you saying instead of having a remote in my hand and doing it when I take it close to the dishwasher, it operates the dishwasher.

If I now take it close to the microwave, I should be able to start and you know open the thing similarly if I take it close to my oven at least I can see the stage of the oven and all that. So, can we make a concept of a remote which can be used for a few gadgets in the kitchen including the ceiling light and in have a work light and then in case you have a, I mean server and shelves.

Under the shelf usually have a counter light when we have something which consciously if you go there I can switch on the counter light and I can have lights inside the cabinet which can be switched on. Can you think of a remote which you can make and make a concept of it? So, thank you, we will meet again.

Thank you.