Electronics Equipment Integration and Prototype Building

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Lecture - 14
Recapitualising a sub system

Hello, I am continuing where I left off and somewhere after about one-third of the, that is a little hour one-third, I thought. I will recapitulate with what I had started, what I had covered a little and in the end try to stay on course.

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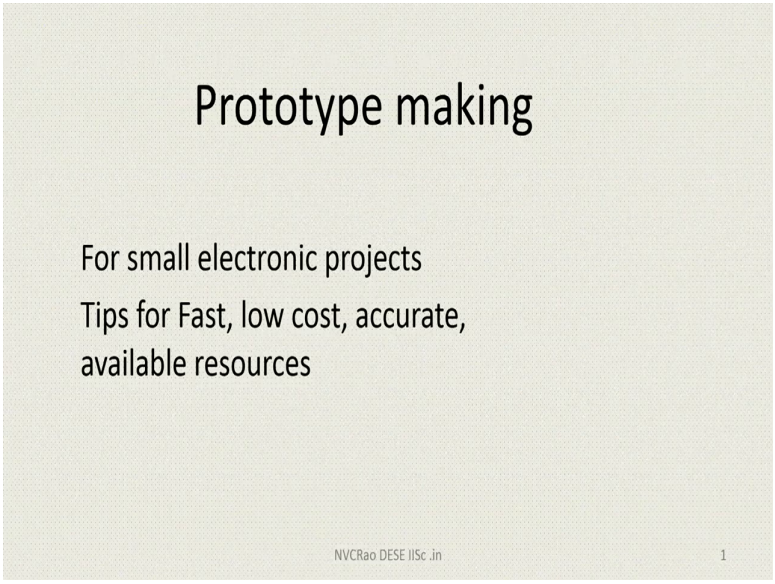

This thing started with how to make a prototype with for small electronic products; fast, low cost, accurate and most important is available resources.

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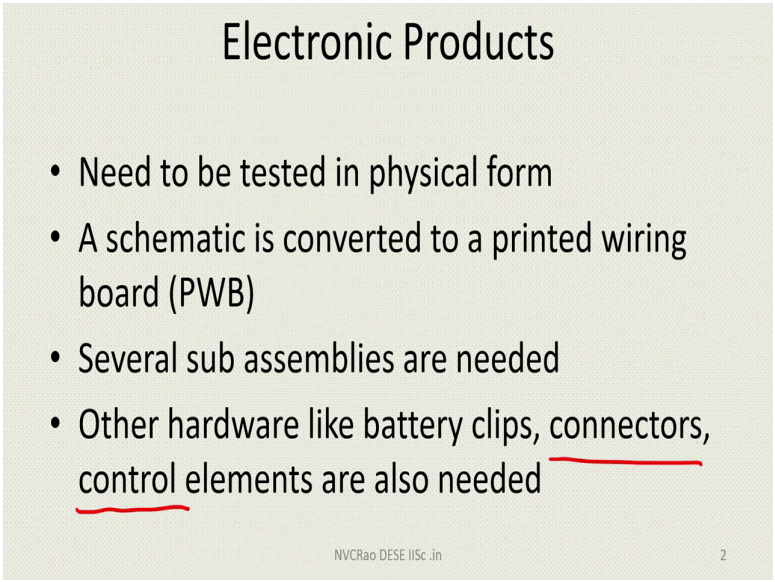

And, all electronic products I think all of you will know probably start with a schematic, it is clear and full analysis is possible for this schematic. Meaning, after you finish this schematic you can run a full multimode analysis, a purely digital, purely analog or combination of both and these days RF and high frequency related to the circuit.

Now, when you convert it into a printed board, we end up with a slightly different thing, because lot of parasitic which are not known end up with the circuit.

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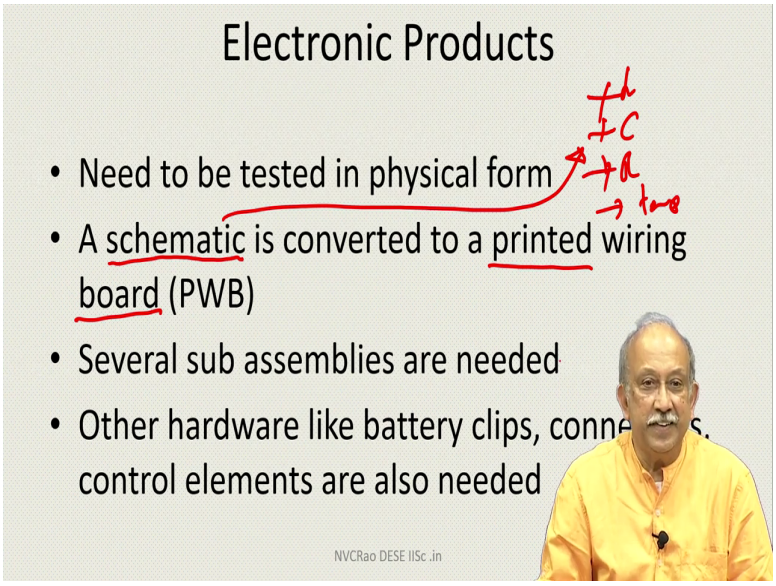

Now, we come to this problem know. The schematic further now has plus, plus, plus so many things. Loosely, I will use the word you know what you call some inductance, then I will put a capacitance, then I will put some other you know unwanted this things and lots of temperature dependent problems because the moment temperature comes all these things changes.

Now, added to that we need to split everything into manageable subassemblies such that it is easy for us to do, easy for us to go about trying to do manage things saying, let us say some circuit can be improved now. You can always change it or next release can be done. Mind you we are talking about hardware, we are talking about physical form and hardware, this is not like, ok. Let me put it the other way, because we not go well, it is a little less free compared to a software module, even there you need to organize things properly.

Next is you end up with several other elements like connectors, control elements, in the case of control elements there is both a display as well as a actual device which is controlling it, meaning switches and so on which will includes for example, keys, switches, potentiometers, rotary devices.

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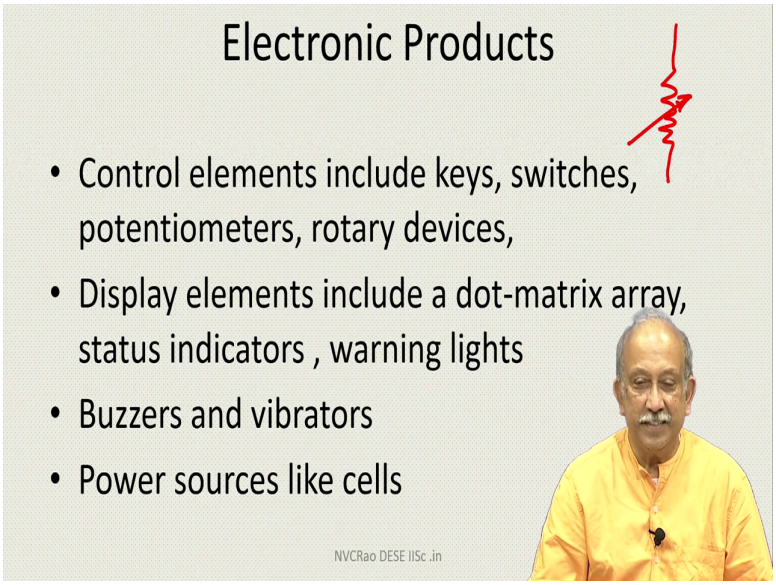

Why did I said potentiometers because in the case of audio and mixers and all that typically there will be slide pots and rotary devices can be anything which rotate and switches can be rotary, keys can be press and what we call the I mean, press and release and you can help potentiometers and combinations of all these things.

In your circuit or schematic circuit all of them end up with a very simple. I will put the good old snake and arrow, but reality it is not a jungle full of snakes, its, something which is full of circuits and physical components. So, when it comes to physical components we end up with

various things technically or as part of the schematic element they are all the same, they have the same thing, a keys can be multiple (Refer Time: 04:52) anything, potentiometers and so on.

Next we come to a large number of display elements. The smallest thing is probably a status indicator which is just be good old, something which changes color, something which another element you know indicate. So, we are all familiar with this; we are all familiar with these things. if you have a motorbike or a car you know the its saying it shows that everything is alright in relation to something which says it light up only when something is wrong.

In case of power failure, it does not mean everything is all right, you know. So, let us say there will be one big indicator saying everything is fine and second thing is warning like, in case something is wrong we know the warning light comes on. Then, this thing are in a way a little bit of detracting or distracting when you need to focus on whatever element you would like to do.

Then for those purposes we end up with these things. Buzzer could be audio or it could be a piezo continuous indicator or it can be a vibrator like what we have seen our cell phones. So, even if you carry it in your pocket, you know that something is waiting for you there and a 97 year old Prof. (Refer Time: 06:32) has been given the Nobel Prize for improving on the lithium cell.

So, read about it. That news came about only, I think maybe a few months back. He says they are going to be there is going to be an improvement, you have enough time. Mind you that gentleman is that professor is 97 years and then he says power sources are still the thing; however, if you focus on it as a advantage that you can eventually live a happy life.

So, I am not distracting, I just wanted to tell you a phone like this, this particular phone I chose, because it has a battery which they claim is 5000 milli ampere hours with small print, you do not need it really because 3000 milli ampere hour batteries seem to be lasting longer. And, this has a battery which I cannot even guess what is inside; I think I should try it here like

this I will show it here. It lasts quite some time, but all of them have one new since saying you need to charge it.

And as of now, nobody has come out with a rechargeable battery for these things. There are rechargeable batteries where they are now good they are absolutely no good and I am waiting for the time probably when you have a wireless charger. So, I wear the wireless charger it will directly charge it. Ratio being as the technology progresses we are ending up with lot of cells which occupy more space than anything else you can think off.

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Now, we come to the interesting part of it where does one start, ok. It is hidden at the back see, where do we start. First thing is where do we start, where do we stop. Looks tough know, life looks tough. If you remember I will you get back again after a little while. I wanted to show you a practical seminar timer which we could all use. I am sure which you also need

to do, if it not a seminar you can practice it and if you are a professional you probably need it all the time.

So, particular device needs something to set the time and we come to what looks like a very simple thing. can we have an on, off switch? And why are they two of them here, you understood. We have ended up with two of them there, I will tell you I think if you have followed my lecture earlier in the timer we made there was a master switch to start the system; one more switch to start the countdown, count-down or count up.

And can we now do something and end up with one big master switch, saying this master switch when I press start, it probably system is on, one more time it starts counting up then I have something here which either blinks or you know tells me when it is and I press a stop and I think you would have guessed what to do.

Now, it comes to the point like that. At this point we probably need to work with other people to see how well our idea can be presented. At this point, it is worthwhile making a simple prototype using available resources directly with you. If you are lucky like us, we have a huge; I mean, unbelievably complex workshop which can do omega all the way to nano-projects, but fortunately I have no access to that and hence I can talk other tritely on how we can make these things.

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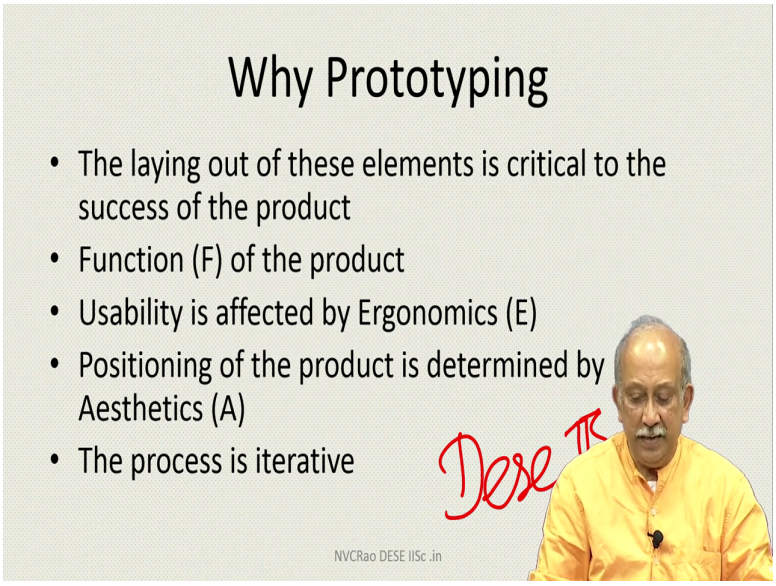

Most important, let me tell you one more time because I have ended up the old thing like that do I start with a method and show you or I will do I make a framework and then go back to the method. So, I started with a simple thing this you would have seen and went and showed you a small project that could be made and I am coming back and interlacing or interspersing the work and showing you.

First thing is function of the product you have seen that know that particular small timer though it looks simple. It does have several functions, one of them is the presenter needs to know where he stands rather you know how much time as I left, how much more time we have and the session chair has to know how many more are waiting and what is the running time. So, it is very distracting both of them keep looking at the time like this, I have done it in some of these lectures, but pardon me.

Then, this ergonomic says how well you can operate the thing. Say in our case nothing will happen if somebody over steps a little longer nothing will happen. Even if somebody trips on the in a fashion show nothing will happen everything is fine and in fact, certain what you call things are used for as part of the marketing gimmick, I think you know what I am talking about.

So, ramp walk falling is common and you too must have seen where one what you call actor fell down and another actor picked the shoes and walked along leaving that see; obviously, there is a little bit of ergonomics about things like shoes. One of them is a aesthetic element is real the clothes, I wear everything what I am shows by what you see. And, same thing it is with products I have one of the cutest I do not know how I how somebody hit up on it.

The advantage of this cute product is as a small little dongle which goes into the computer and then I can play with it and show you have seen this. This hunter's moon is rise in slowly behind me, you know that just one of those stupid funs and I can even point out or make you follow certain things and I still have this pen. Now, we come to the thing of how easy it is to operate these things, it is simple I can keep it inside and I understood it is wireless. So, I need not point it anywhere it just works on its own.

Then, aesthetic elements seem to be very critical. So, I have two, I do not now I think mouse's is quite acceptable if I say mice it looks funny, it is just a pointing device. In fact, I have two of them one is extremely shiny and one is dull, ok; both of them have a wheel, both of them have the switches and the one that is shiny also has some place where no you can grip properly, common thing no more tail.

I was holding the mouse in the wrong way, first time when it came when I found the tail this side I was holding it this side. And, called a person who solved the computer saying it is not working, then he told me yes sir you cats will never understand blah, blah leave all that.

The advantage is if we have to make. This part saying you decide upfront know, what is the function that is required, how much of is very critical, then the ergonomics that is required,

then the aesthetic elements that are there and positioning here refers to positioning in your mind with respect to the marketing. Marketing, again is not selling if somebody tells a lot about your product that hype now will probably reduce your chances of acceptance.

However, you suddenly discover that it is it is useful I have it, I am surprised at it this is made for a person who does it presenting. It is not similar to the one which we had here, once upon a time we had this thing is not similar to that this is exactly meant for this PC. So, I can write anything, goes well and by just touching it know everything vanishes.

Now, suddenly I discovered this just now like last week my senior professor was talking I was very happy about it, here we come to the important thing saying this process is iterative. So, in this context probably a mouse is not that useful, I am sorry, mouse is not I will not say useful that appropriate for this, but then they this device only works with a touch pc and it is it is big that is all I can tell.

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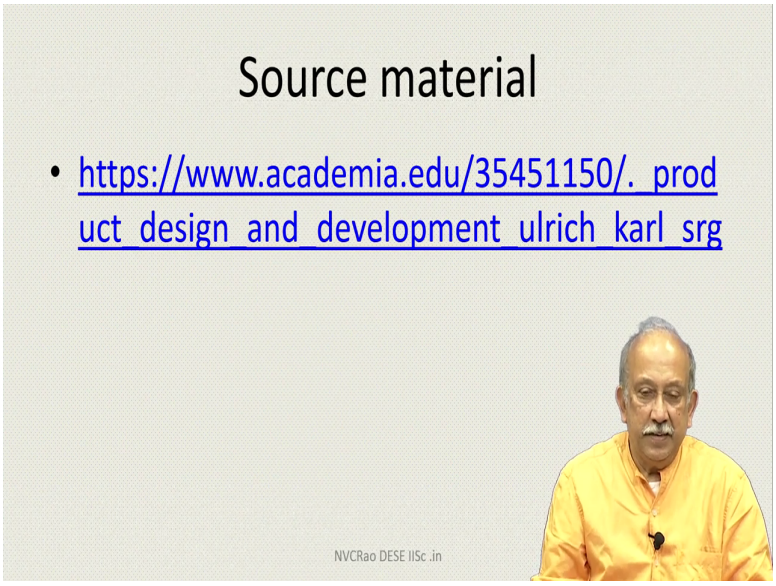

So, I will go on to the next slide. Lot of my material I have used from Ulrich and Eppinger.

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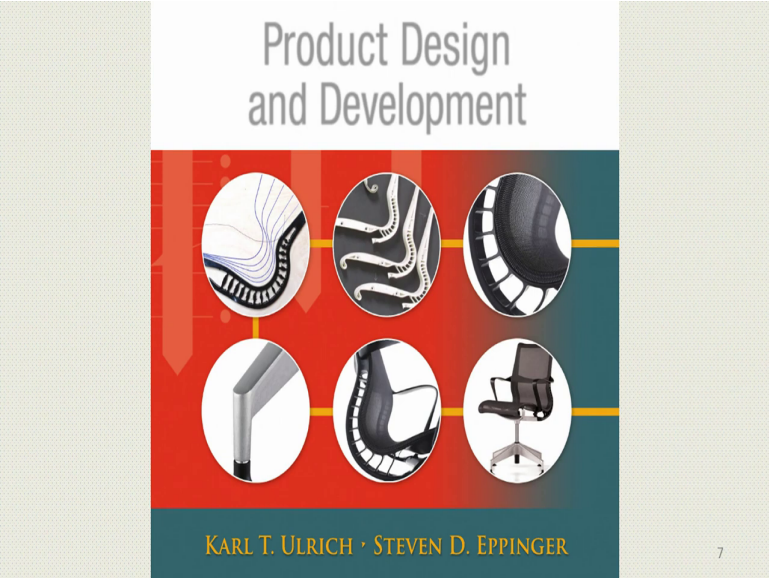

So, you can just try to see Karl Eppinger; I mean, Ulrich and Steven Eppinger. What to look like very simple things here he has taken what I feel is a very appropriate thing as of now the best chair has not been invented, you pay more and you not very useful. However, if you go to a dentist,yYou notice the dentist's chair is made for the doctor very well, a dentist chair is a beauty; unbelievable beauty.

Similarly, I will not use the word barber if you go to a surgeon and any of the operators you are likely to say an operation theater all made specifically. We have seen that that is where this ergonomics plays a very crucial part in it. So, the cover itself know shows everything and my suggestion is it does not matter which edition, it is go get one and buy one, it is something worth keeping for life; stealing I do not agree, but maybe you can borrow and pay in kind.

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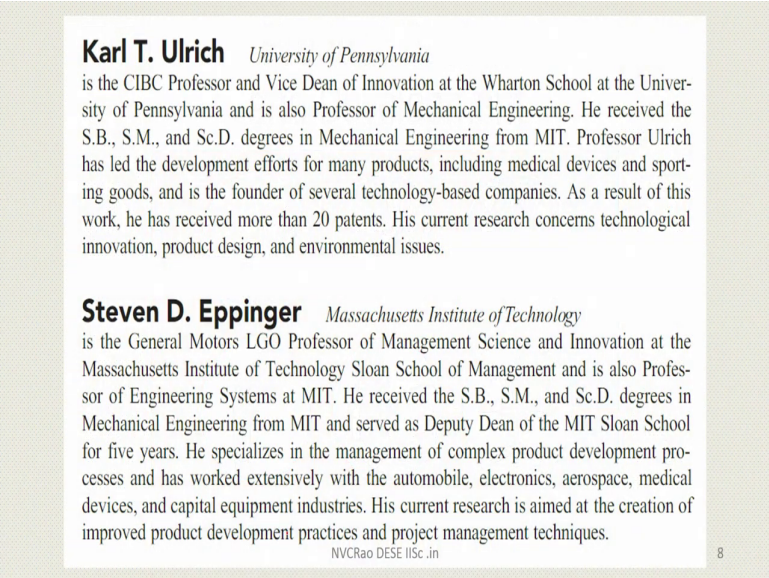

I must choose this word MIT, then it gets a and this is where medical, sports, technology based companies. So, that is a beauty and Eppinger is probably continues with MIT, it is not easy. So, one thing I would like to point out that Sloan school focuses in management of complex product development process. So, this is a small subset of it, probably the very starting point of it is you need to find out what is the marketing position that you require for the product. Because, technologies it is definitely standard, but how do you know trade off all the various issues and make something is very important.

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So, in this in this book several of you have come one of the thing if you see there is this product development process important thing is this planning and customer needs are the important thing. Saying, what does the customer need, then you come to industrial design which integrates all these things. I have worked with two industrial designers, but by practice, I am not a by practice; by I do not have a degree in industrial design, but I am a management person. So, I go through all these things up to here I go through.

Now, which we come to this important point you see prototyping, and something related to this is managing and economics; this is where I wanted to what you call stress on the thing saying.

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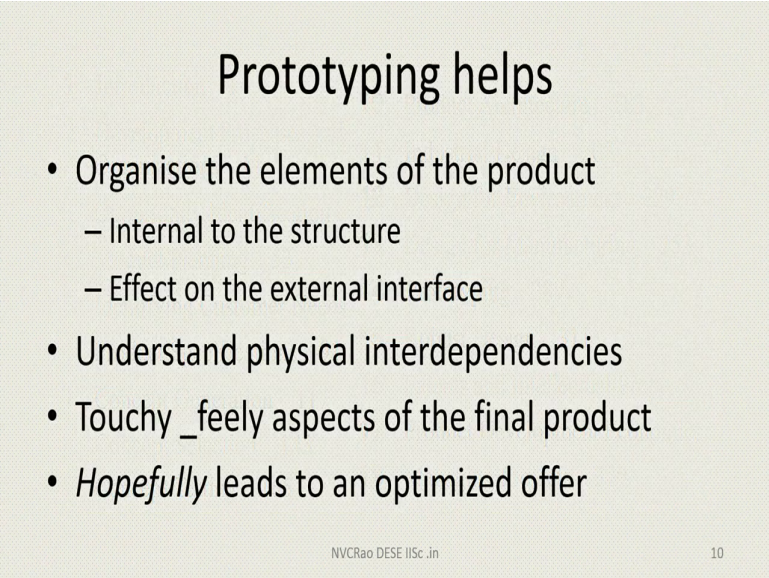

If there is a inexpensive way of making something quickly, it is fine. As of now, rapid prototyping is still a little more expensive than what we think unless the channel or people call it the full ecosystem is established, it still take time it is expensive.

Prototyping essentially helps organize the internal elements and external interface. I am sure you too would have read about how stressful and how complicated, it is to operate a machine tool of the earlier generation things are you know; I mean, there is no way of easily operating it everything is complicated. You have something which is you know put somewhere away you need to turn and you need something and you have a bar at the bottom, and they are all very widely distributed, it is not easy absolutely a problem.

So, we have a little about loosely i have used the word physical interdependencies. Physical interdependencies talk about how things internal to the structure affect the external what you

call dependency. So, even a small thing like this wireless which I am carrying, everything depends on everything else. So, we know about it.

And finally, we come to this thing saying how do you touch and feel the object and how people feel comfortable about it, most important is that. Touch and feel is our interaction with the world; in fact, one extreme they say a world may not exist, it is a little like the matrix; saying maybe we are being run by something blah; so, right now this is not a philosophy thing.

But once, you do this prototyping and do something about it hopefully leads to an optimized offer. And again, I think if you had followed my earlier lectures you know that this is not a single man or what you call single team effort.

The output depends on several things including even what looks very simple here is, it is I understand it has an rf and it has so many things and it has also a I do not know what you call that USB and how it is working I do not know. Obviously, somebody has thought about it and put everything neatly in a beautiful case and this is where it comes even it falls nothing less likely to happen, most likely this one is a thin aluminum extrusion and by definition 5000 series extrusions are quite strong.

So, if they had packaged everything except for external physical damage it will not get damaged easily then all the case very peculiar layer, soft whole thing is soft and there no what you call pocket surfaces. So, the moment I got it I liked it a lot sadly there are three cameras here otherwise, I would have stolen it. And, probably is wireless know can be activated and they can find out where I am otherwise I would have stolen it.

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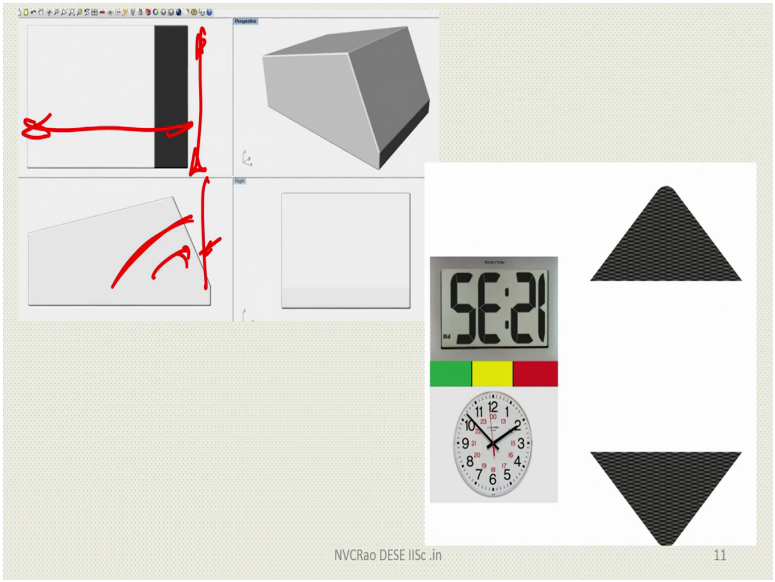

I started with this if you remember, this is using some what we call 3D modeling software, it came out with a nice front panel, its angle has been fixed probably a little bit of study has been done and things inside have been nicely arranged. And, we have ended up with reasonably good form and the punch line is it is improved over the existing one that we have.

And, this is taken in a what you call printer at home and if you had followed my lecture you know that this one faces the session chair, this one faces the what you call the presenter. And, this is part of the other makeup and the whole thing has been made in it has been made in available cardboard and presented to an audience of not the users. Users also will eventually come into the picture, but to the other group saying is it possible to make it, while to me it look like a fantastic idea there were some shortcomings in it which right now I will come and it will be distracting I will tell you.

One of the things is saying even if you have it here on the table people will be distracted, they will keep trying to look at it which is not correct. So, logically it should be where the presenter is looking, but not that easily visible to the others. So, good old wall clock mounted on the wall in the normal time probably will make sense and only the auditory buzzer will make sense anything else is a redundancy.

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So, I will go back these are supposed to be some, I do not know some concept wise. A very simple thing like just showing you earlier as a switch to switch on and off, when you actually look around for the components you end up with all this what you call too many options, not easy to decide what to do.

Here they have just be in (Refer Time: 28:06) scaled approximately and there is a certain what you call expectation. Saying if you have a switch like this; obviously, 0 and 1, I do not know

what 1 means and what 0 means, is O is out or is it I is for in or what it is I do not know, on-off seems to be ok, but what next.

So, a color coded is better, but again once again its positioning is wrong. Traditionally, it has been accepted that green is for start and you press anything red which is for emergency stop and for all stops. So, they should have been rotated. So, what looked like a very simple way of organizing things suddenly we will discover it is not as simple as it looks.

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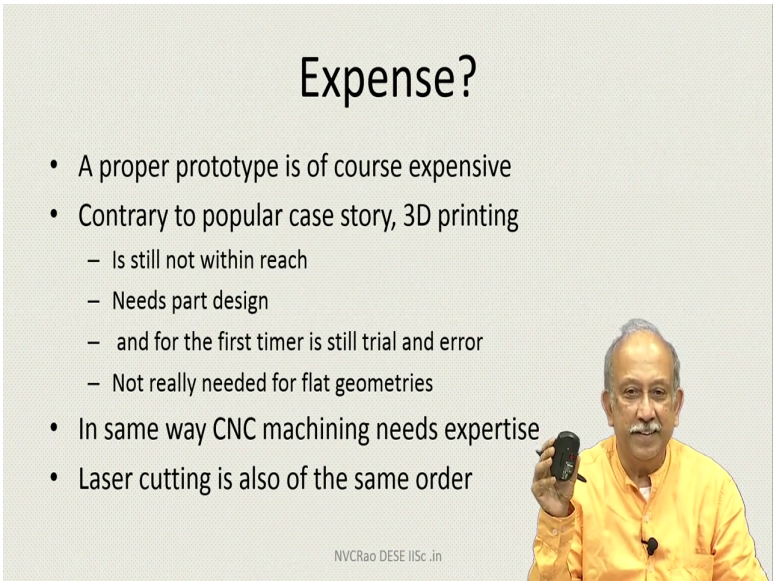

And if you want to make a full fledged prototype, it is expensive. One of the first thing is you will be spending a lot of time on follow up. Contrary to the case stories you hear 3D printing is still not as easy as it sounds, still you require a person who will be able to deal with it.

So, as I have explained earlier a very complex surface like this does not print well in 3D, because still it is a build process and somehow somebody has to still do something to make it useful. So, the thing about touch and feel does not automatically come with these things; however, few things like organizing the inside and showing to the downstream fabricator, it is useful. And which we come to the very important things every part in this needs to be designed, it is not as easy as it thinks understand know. So, every part of it needs design.

So, we end up with probably having to learn solid modeling and design of parts is still a specialist activity. And for the first timer it still it runs to be a trial and error unlike a hobby in which things are fine, in this case things that not that fine as it is and. As I have explained to you here, if it is a flat geometry it is much better to be done in using some other form.

Typically again, once again if you had followed my lectures typically it is done either by hand or by cutting flat sheets. Typically they could be acrylic, polycarbonate and so many of the other things solved by using a laser cutter. But even there if it just make things and try to assemble them it does not work well.

So, I had given an example of the raspberry pi beagle bone and so many other things were including the Arduino where the boxes are available. Well, that is to try and learn about Arduino and use it as a subsystem, but if you were to build an actual device like this. I do not think that is the way, you do not need to make something is bigger it has to look like this or like this. I am not sure whether it has what is the device it has inside, but in the end it is packaged well.

CNC machining needs expertise it not as if you just you know I give a file and they call firing a job, it needs trained operators and its much more complicated. The only advantage is first time if you make a beautiful proven design making changes and improving on it is very easy extremely easy and multiples are easy and mirroring is easy.

And, for the first time after a long time design that is conceptualization detailing manufacturing can be far away, you can design something wherever you understand the

market and wherever probably know that particular item is in it can be it is useful. Get it detailed as where engineering design people are sitting there.

And finally, get it manufactured where whoever is ready to give you in the time in the job order quantities ended the eventually leading to cost.

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So, and laser cutting also comes to the same order. This I will skip through a little simple desktop or laptop is enough, lot of you know frigate modular software server which I showed you. Laser printers meaning paper laser printers are available you can share, you can I know huge amount of friends and expertise is available.

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And, any amount of these resources are there on the internet saying how do you organize a front panel. This obviously, is part of some game, this is real, this is all part of; actually, equipment's are available this is I am not very sure it is actually retro or it is a style or whatever it is this is still current. You can fall back on this and you can always make a model using these things.

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I think I have gone through earlier we made this; however, we are updated I will continue later on. This is something which can be used as part of the 19 inch rack system, but still be a table model and our concept did not come out rather what I have written then come on. Because, I wanted these things to be visible very distracting and it best it can be described as ugly. Somebody it says, it looks like a advertisement for a circus, this is the real product that was made and mind you it was made 20 years back.

Advantage of it is it can be used in a rack, it can be used as an it table and it has all the elements of acceptability and it use and it does not follow that 3 by 4 or 4 by 4 matrix keyboard on one side and a display and old 80-85 kits the start with go one say 0-0 that is what we all were brought up with.

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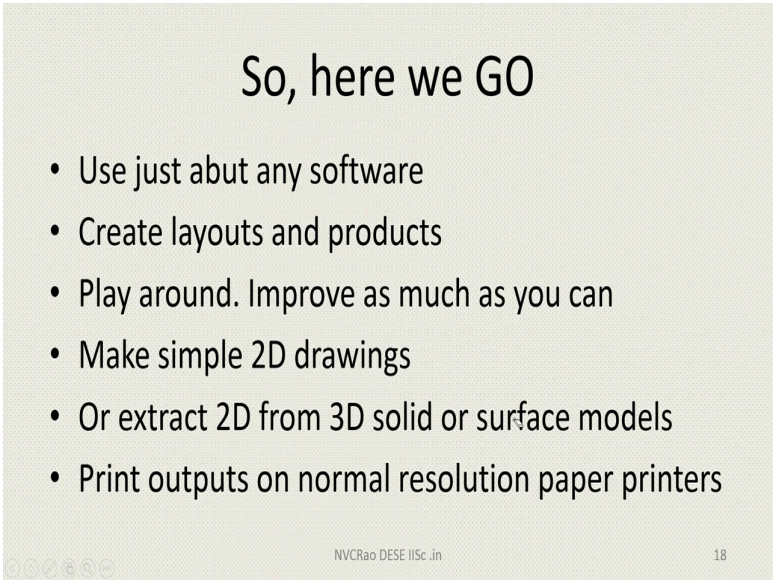

I will repeat this again after I continue this lecture.

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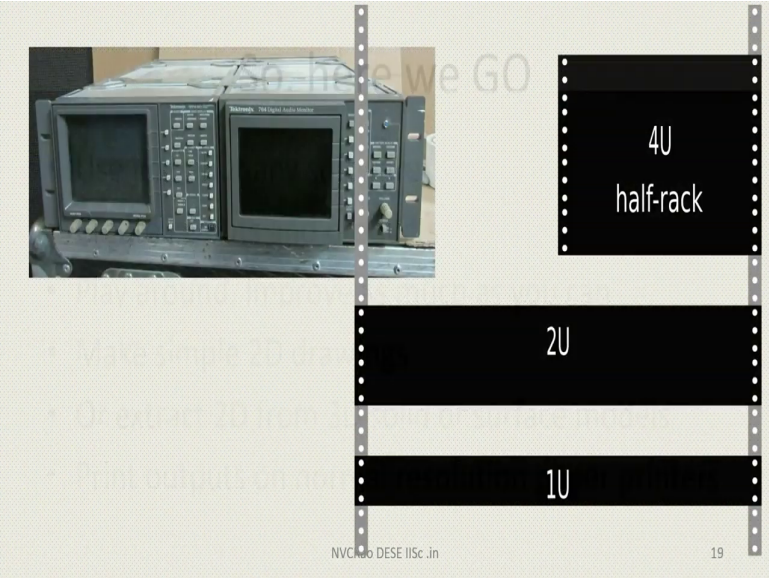

And I will stop here saying, the devices that are shown there are all meant for being fitted into this rack. Saying, there is something called a 4U rack and how the dimensions are being derived, how the height has been derived this width and the depth and more important is saying it should all be manufacturable and repairable, because this are not single use throw away product, something which is made is expected to last forever.

So, thank you, I will continue this from this point next time so.

Thank you.