Enclosure Design of Electronics Equipment
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Lecture - 51
CAD for enclosure Design

So, I am back again this is part of the series of lectures on how to make an enclosure for various types of electronics what you call projects, instruments, are designs. As I have told you before the concept probably starts in your mind saying this is what I would like to have in the end even what you have in the mind may be something which has started a little earlier or has been there for a long time, one is when you have a focused what you call requirement somebody says I want a proper controller for my air conditioning in the house. I think some of you must have also felt it most split ACs which show a timer what I am sorry the temperature which is their whether they show you the set temperature or they show you temperature of air that is coming in air that is going out very rarely about the actual temperature in your immediate surroundings.

So, now let say you set about making it and then you are reasonably thorough about your electronics and various things. Now you need to put it into an enclosure or build an enclosure which is aesthetically present that is somebody would like to buy it, and it will also show you what the current temperature is and then what this set temperature is so; obviously, you need to start with a model. And it could be a sculpted model made out of form or it will could be a cardboard model similar to what I showed to earlier or in the very initial stages it can be just a nice enclosure in which you can put everything; and write eventually somebody else designer will convert it into a designed product as in design so far I have covered lot about how to give what you call IP protection, and how to select connectors and all which will make things inside outside and a little about safety and then how to make sure that the temperature and all we have separate issues with it.

Starting from the last lecture I thought because of the partly repetitive and partly what you call calling on earlier experience and various hardware, we have to start using computer aided design software. Again as I have told you earlier simple two d has always been related to either mechanical or construction civil construction drawings and then part two of it was used to convert three view engineering drawings to make them useful for

machine operations in the fabrication shop.

Including sheet metal and then parallely illustrations and other three d solid modeling software have developed to make products which are properly aesthetically designed. So, if I take a thing I keep showing you this mouse because is handy object not easy to get to where they have got tough tomorrow I will try to bring a very narrow mouse.

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If you can now follow the monitor yes cad anyone now cad everyone there is nothing like it is a retaca rhetorical question including all over the world people are trying to convert existing what you call arc, I would things into a digital formats simplest was you scan it and just store it saying someday this back up will be useful, someday software may come which will read these lines and then try to convert it into digital formats. Simple when they say digitization it is about storing archival information in a digital format, which happened with books which happened with popular things like, the national geographic we went and bought a huge national geographic collection and it turned out its scanned and not that very readable in the old format, but still I like it because I can read it now things have changed a little.

Now, since then first thing is you can read it along with me and each point I will try to

elaborate it little one of the. First thing is they suppose to make things easy, thing is making thing easy is full downstream all the way down including upgradability later on.

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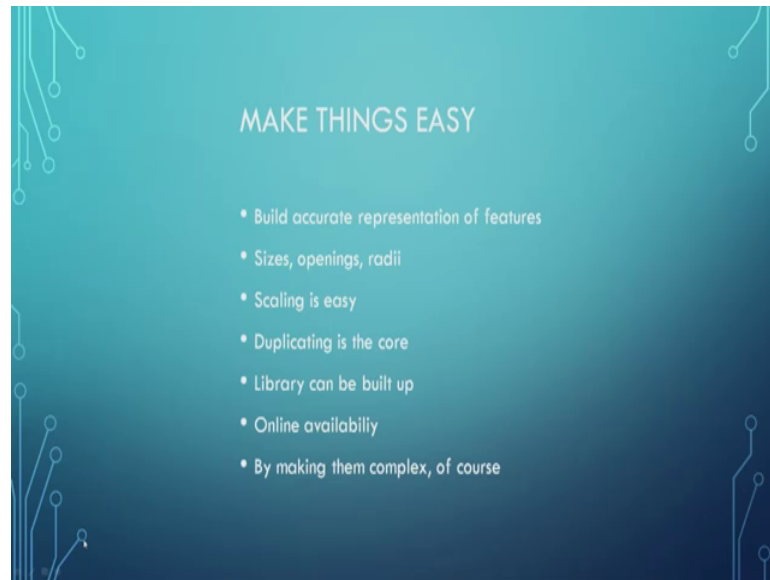
If you want to change one feature in the earlier lecture I have covered about so, called bidirectional associvity. That if you change the dimension the feature representation changes if I change the representation that is if I change a radius automatically dimensions get updated. So, last one is t looks a little complicated saying nor we not making it complex to make it simpler yes, it is like this you have no choice if you want to use a coffee maker; obviously, the simplest way is you mix some what you call cafe soluble in milk or water and drink and then maybe you heat.

The moment you want to make next level you need to make a put powder into something and add water and then it filters and then you have so many of them including cafe expressive and so on and all that. The last point is probably they are complicated, but then it taste much better. So, let me get out of that what you call allegorical representation and go back to the thing first of it is accurate representation of features. Main thing when we talk about representation when we call a line saying this is going to be 75 point something something 76.2, it will be 76.2 and then the advanced software will also add a tolerance on the dimensions.

So, if I have two openings like when see here you can see luckily for me on the screen you have an opening here that is a probably wire a hole of a pcb and across I have one more opening here. Imagine if I now tie this dimensions depending on the fabrication and depending on the tolerance and all that most xy machines; obviously, have a horizontal x coordinate system and then similarly we have a y coordinate system, and then there is a resolution and what can be achieved by the machine.

Now imagine I have some mounting holes and there is a tolerances associated with it this has to match in ordered conditions, and sometimes it is expensive in fabrication it may be expensive, but in the case of a drilling in a printed circuit board already the resolution is as high as we expect. So, we can keep the printed circuit board this whatever it is know the you have a feature here then oh which way I am moving out let me take it out from a rival feature there then I have a feature there. These features can all be tied together and then generally the printed circuit board tolerances are much tighter. Now if you has to go and sit on to a let say an enclosure on to four spaces it will sit nicely, this is where the accurate representation of features issue comes we have.

The next level if you have seen all the connectors and all which we have checked about all of them come with a dimension all of them come with also tolerances on the dimensions and also specifications of what should be the mounting holes. I have given you the example of the connector which is mounted with a flange with 4 openings, then I also given something which has got a bulk head mounting that is a d type of mounting. These features comes easily in the case of cad where you can build I am sorry library components.

So, if you look around your thing know you will be a specialist in one area. So, when you are a specialist in one area you use one set of components and all that which have been tried tested and probably type a probe. So, you have a beautiful library which you can use in your fabrication, and electrical are what you call technical electronics engineers can use the other characteristics of it. Now if you see we come to the next thing about sizes openings radii and all, these one is the desirable thing what we want understand the designer wants something. The other is what is economically feasible in the fabrication shop. So, once you standardize all these things t is very easy for us to play around with rather rearrange things. Something little related to these is scaling if you see most stand

offs fasteners hinges all these follow certain proportions.

If it is a three quarter inch I am sorry 19 mm hinge it has certain proportions nested something and. So, on like that and if you take things like metric screws for that matter any screws you have a nominal screw thread and a nominal pitch. All other proportions are related to this nominal screw and pitch most cad programs allow us to scale up these drawings without any problem. So, you can keep the screw as it is and then make it a little longer typically if you take a m three screw and then you let us say you have started with a ten mm nominal dimension if something goes wrong, can always reduce it to eight similarity we can increase it to next higher level, which determines say height of all other features of your product and main thing is ability to duplicate things which have created already is the height of these things.

To at the end I have a sample I will just show you how we have achieved it. So, when we talk about duplicating is the core (Refer Time: 12:02) one place you need to probably give the necessary openings. The most advanced software allows you to change the whole lot at one place you just type and the new numbers and everything gets changed everywhere, but it leads to little bit of confusion and then people like me are not that familiar with the most advanced software you find it a little tough to deal with it, but is very easy to learn you know one you know all. So, you can exchange library components across other professionals, you need not be what you call tide down saying.

I need to meet the other person to see what is using you just need to get the information by data exchange, and then you have a library and then you can restrict this library components. So, if I am talking about a bnc connector which has certain what you call connection at the back of it the front part of it is standardized the at the back you can have a solder part or you can have a crimped thing or you can have I do not know one more adapter at the back across, the bulk head all of these can be standardized and I am sorry to the related to this itself is the online availability. I have shown you examples of the standard enclosures where all the information is available on link with of course, a little small this thing saying information usually is not at least the one that is not contractually accepted is not updated so frequently. So, if you want any updating of it or in our case you would ask something saying I do not want this quarter inch what you call UNF screw or one eighth inch I do not know such a thing one eighth inch (Refer Time:

13:59) I do not want if instead.

I would like to use a m 3 screw. So, material you receive may be in the modified condition, but the catalogue still refers to the old condition this is where we need to make update our library and will come to the last thing slowly will notice that complexity is increasing, it looks you know oxymoron how to make something know easy complexity or complex ease with which we solve problems main thing is downstream production or economic prod usability is the focus.

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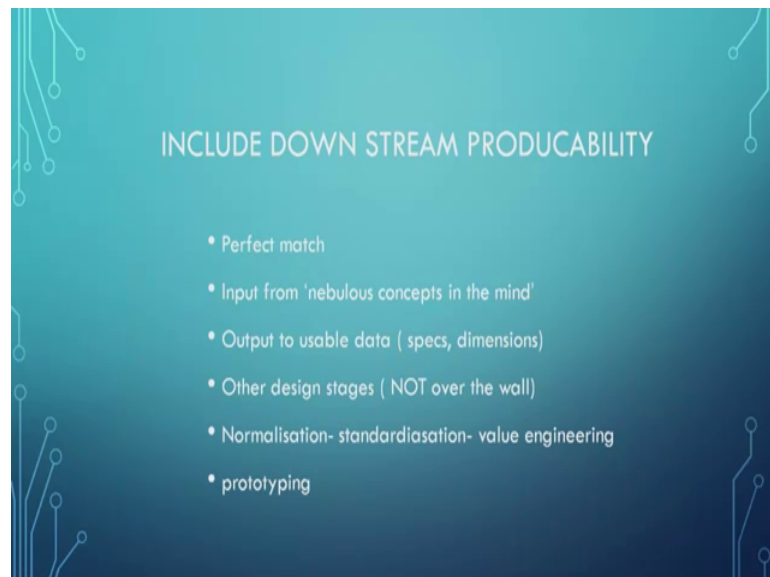
First of all everything matches perfectly everything just about everything matches perfectly input is from nebulous concepts in the mind somewhere as a stroke of I would not call it madness inspiration you would have got an ideas saying I require this feature in the new product. So, from there using cad very easily you can convert it into actual specifications and dimensions. So, let say you have a remote control and then you need to put a joystick on the remote control. So, it is easy; now all the upgraded TVs now what you get already have a provision for connecting need to the I mean I will use a word like internet please put up with me because easily better understood directly you can make it connected to other resources you can have a wire now these day even wire also do not required you can have a smart TV, which has built in Wi-Fi and then you can stream content directly on to that or access using, that small one more button on your normal tv

remote and then is I have not seen anybody actually use the keyboard which is you know put on the thing you have like you know so many numbers and selection of a thing and all that know may be it is redundant eventually in the future.

If you make your own what you call smart TV remote probably a set of things you know it may end up, with your like a cell phone which has a nice beautiful flat gorilla glass screen then you can configure the buttons you want including channels you want and all that and including other you want to switch between the what you call connecting it to the servers and all that or we would like them stream them directly from the satellite or in case you have a set up box with a cable, that also can be used. When we are asking is it the not the same no satellite does not come when it is raining and set top box with cable even now works reliably and is a little cheaper than we call the things. So, I where I use I have both of them I can choose one of them.

Now you see here very important thing is this design stages downstream producibility with other design stages not over the wall. When I say over the wall let us not as if you (Refer Time: 17:26) freeze all the designs and then just you know pass it on saying please take it on from here and then I am working on the next project. Advantage here is simultaneously online you and your design engineers then the packaging people and down the production people can all work together, you understand know one side we had the hardcore design like this. So, if you take as I said even if you take a normal thing like this mobile phone I am surprised at the type of features it has come out with.so many antennas except that wireless charging all of them.

Seem to be at least I am able to use all of them and another thing little related it has cotton and not yet fully cotton is nfc. At one time when NFC started they showed as a phone you show the phone or walk near a coco cola wending machine or I will say any cola wending machine, and then automatically you can get the cola and then for sometime at the same price as you would get in the retail I thought it was a very good system, but then I did not take off as I expected it when I walked by the machine nothing happens.

Next thing talks about normalization standardization value engineering. So, I could not find a better word because standard talks to talks about how to things do not fit. So, you have a (Refer Time: 19:02) say come parallel standards normalization, talks about how to

make everything about as flat as possible. I cannot define these terms, but expect that within your enterprise and within your area of expertise features verses cost can be optimized nobody really wants to buy a cheap anything inexpensive is probably a cheap even semantics indicate that it is unreliable if you can afford an original watch you will buy it I do not think you will buy a replica and definitely you will not buy a cheap look alike value engineering instead talks about trying to make offer features know at a reasonable value.

Next we come to very important thing prototyping; if you start your design in a cad format prototyping appears to be very very very easy. So, in case you want you can use sheet metal, in case you want to use what you call some polymer or plastic sheets you can use it there for laser cutting and in case you want to do 3D printing you can go ahead and use it for rapid prototyping then in case you want to send it for the machine shop with the CNC machining, you can do it and things which I have not mentioned earlier including spark erosion and wire cut electro discharge machining all of them inputs. So, that can be stri; what you call seamlessly brought in from here.

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After having worked with this for around 25 30 years I seem to enjoy these things I am sure each of you have your own reasons for picking it up one of them is primitives that we use are intuitive. So, a line is called a line and then of course, a circle is called a circle

and an ellipse is called an ellipse.

Now, we come to the other beautiful these thing suppose you take an ellipse you take the minor axis and rotate around it you get an obliged spheroid suppose you take the major axis and rotate about it you know you get a different spheroid it looks like a so, called classical American football. These are all to me this looks very intuitive in producing things. Now you can you can always build very complex entities using basic lines I have two lines you can as I said in space 3 points can be located in space and a single triangular plane can go through these 3 points and this is a starting point for all mesh and including hyper mesh. So, from basic lines you can contain surfaces as I have told you last time we taken take a flat thing with 4 corners if you bend it full turn around one of the diagonal edges it will be two triangles. Next comes if you see any cad package one of the first thing you will notice is that so many unexplored features which we did not know could be useful.

So, two ways of you know looking at it is one is I want to do something and how to do it another is what is the tool which I have know what all can it be done and then there always patches, 4 another thing is selecting of objects on the screen. So, most of the current thing allow you to select only certain features there certain of them can be locked and when you lock them everything does not get selected position is locked something which I like which as I said now what gets my tension is concept of layers it is to me is a god send which we could not do earlier. So, what is presented on the screen is actually something nicely flatly merged features which are there.

So, in case I want to have a mounting holes mounting holes four of them can be kept in one layer I can switch it off keep it there and so on or keep it locked it such that I cannot search for it the same thing can be used with the printed circuit board the machining thing as well as the enclosure design which I am trying to do. So, it is perfect and once I fix dimensions also of it easily can be fixed something very much related to this is various types of attributes of this entities simplest thing which I can talk about is a line where to work backward you still have to make provision drawings which are look like look little like what was there earlier.

So, things like on easily converted into a dotted line and if it is a line of symmetry, usually

we call it an axial the thing that has its own representation. All these can be made easily a little related to this is how they appear on the screen the color of the particular thing and then something related to layers and all that as you see in the next thing, I will try to show you something related to the layers and all that you can make some of the features take the color and attributes of the layer on which they are or separately on the. So, when you look at the color of let say some outline you will know automatically which layer it belongs.