Electronics Equipment Integration and Prototype Building
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Lecture – 06
Early First steps
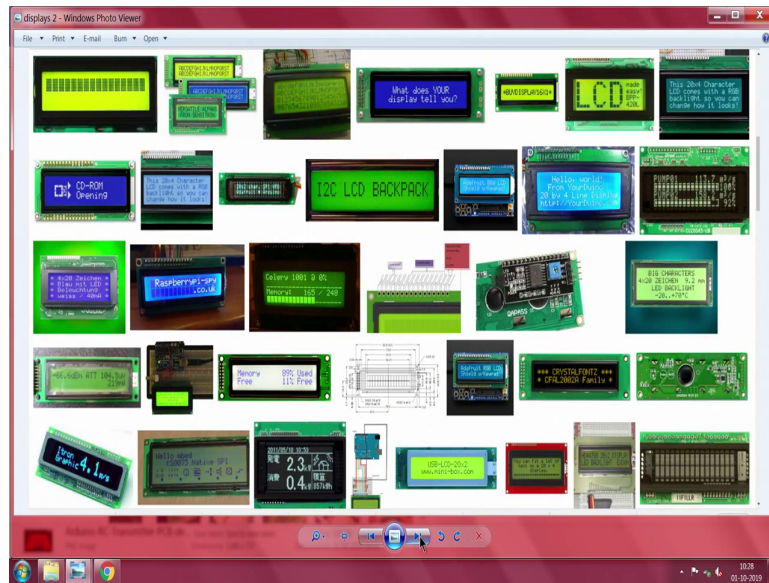
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Hello friends, I will start where I had left of last time. So, if you remember here can you please show this? I am sure some of you are familiar with what this item is. This is taken directly from one of those, what you call websites. This is a printed circuit board. Probably, schematic capture and layout software, why I have taken it is here is an illustrative example, which I am trying to walk through with you which shows how people go about their things.
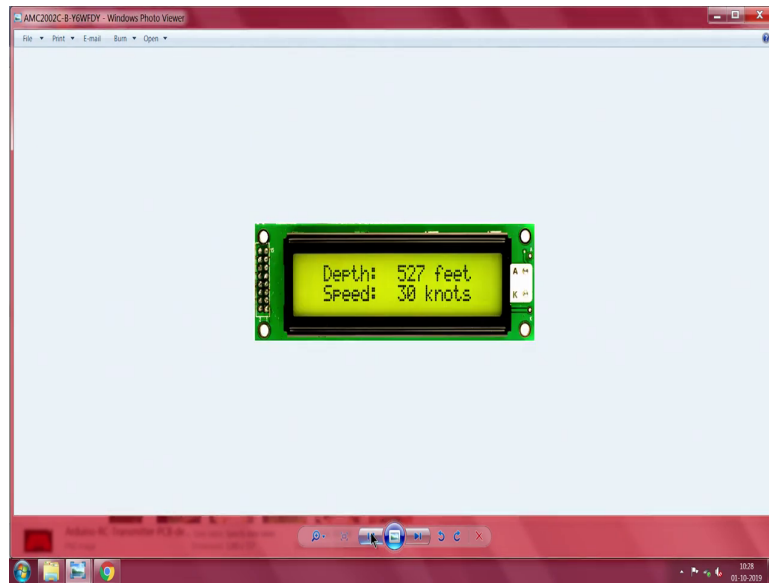
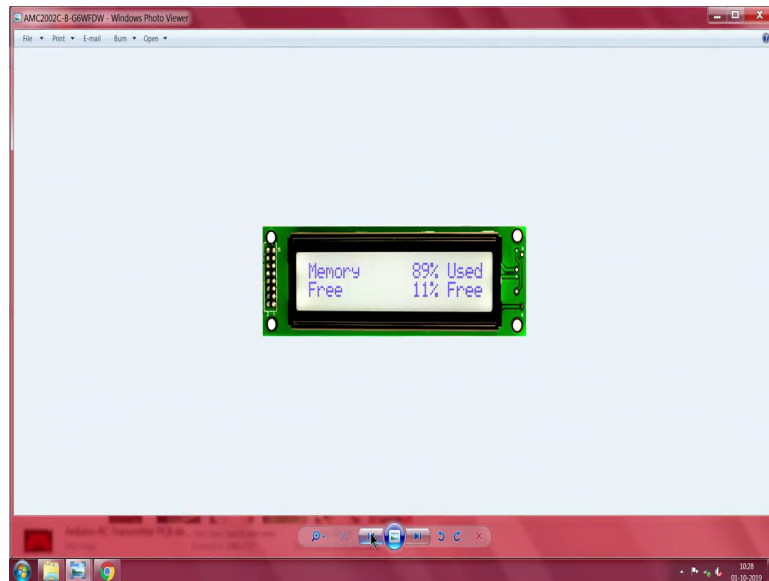(Refer Slide Time: 01:15)
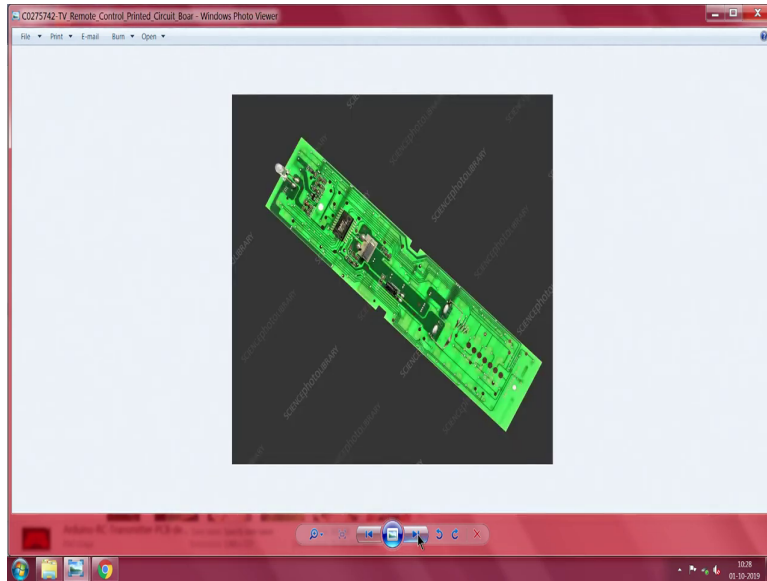
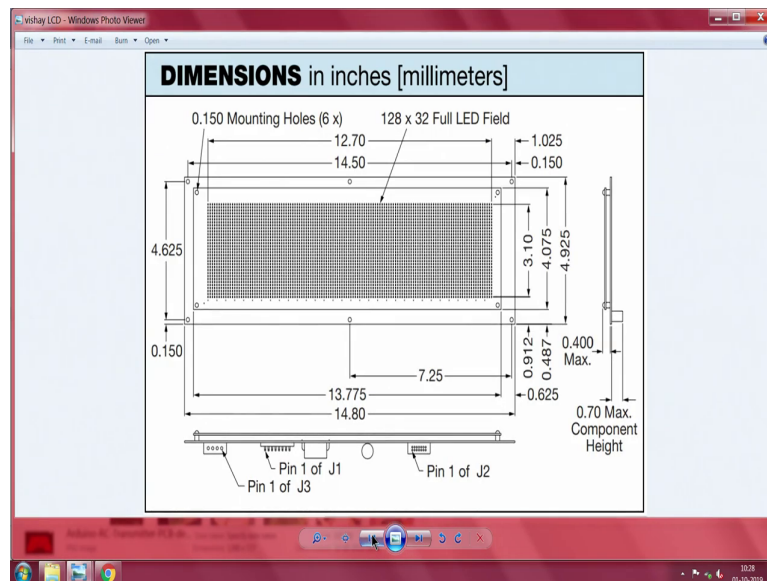(Refer Slide Time: 01:19)

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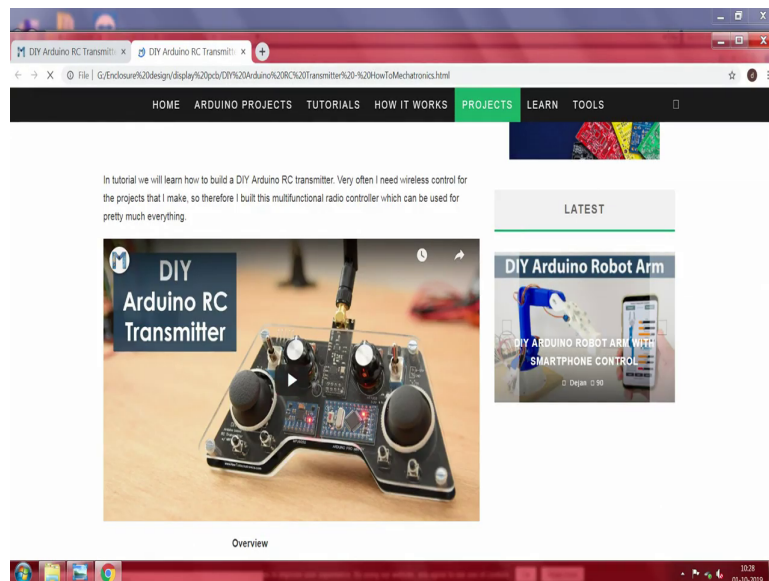
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And you see here, you remember all this? I had already shown you all this things earlier, saying somewhere we need to start about it, probably have a schematic capture what I call software.

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And now comes the other thing; which comes first, do we have the egg or the chicken or the egg syndrome. So, I think you can read it by yourself; it is a Arduino RC transmitter. Why I wanted to show you this is there using the standard Arduino chip, but trying to built things around.

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So, I think you know you can probably go around and see and all that. Probably, the very starting point of all these things you know is this it is a it is not a full pledged what shall I say, regular schematic diagram neither it is a what you call full layout of a this thing on a breadboard, a breadboard will be much wider, while schematic diagram is more of the higher level.

But, what you notice here is that everything is already nicely logically split into sub systems. And for a little bit of convenience sake they have made things look a little like how the final what you call the layout is going to be. So, you see here there are buttons there are buttons and right now you know I will not talk about it, probably it is a joystick.

And there are something here for may be more buttons and then you have a something here and so on probably, for the; so here see most important you have seen this here the something needs 3.3 volts and recommended come from a dedicated source.

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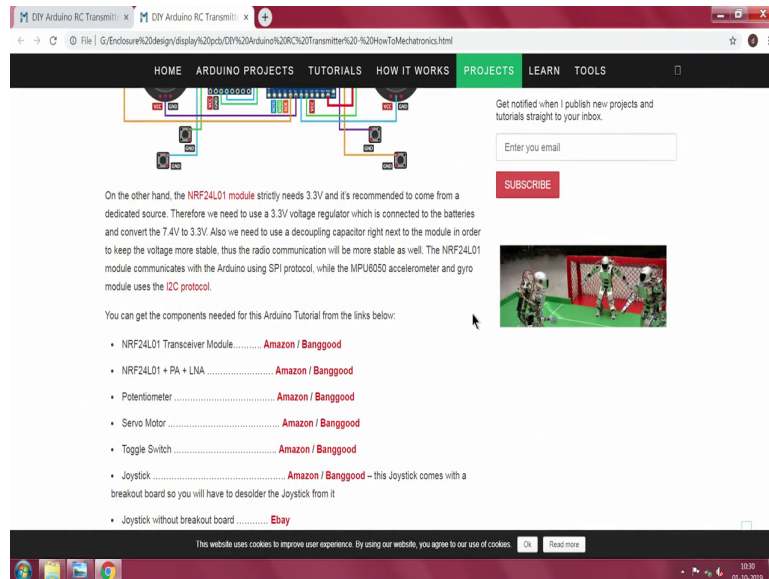
So, somewhere you have to take a decision and get into this PCB Design. And again once again this PCB design is very much dependent upon the layout of the final project, what should it like to have.

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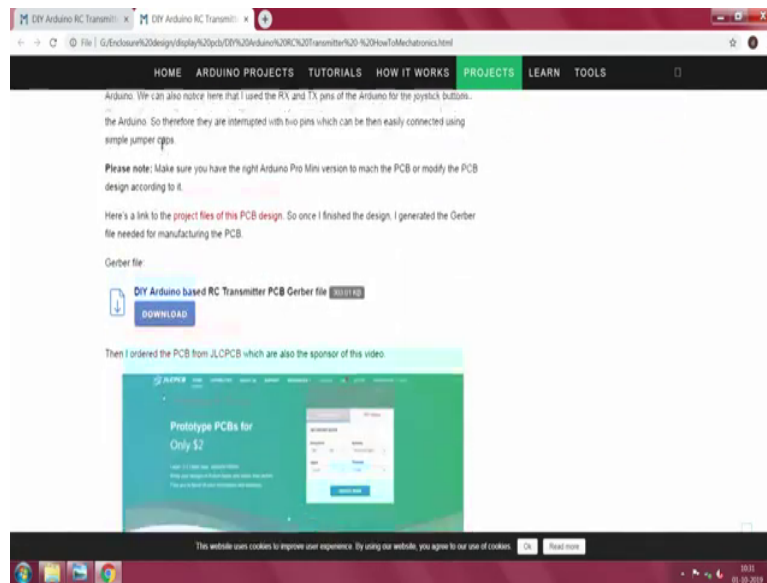
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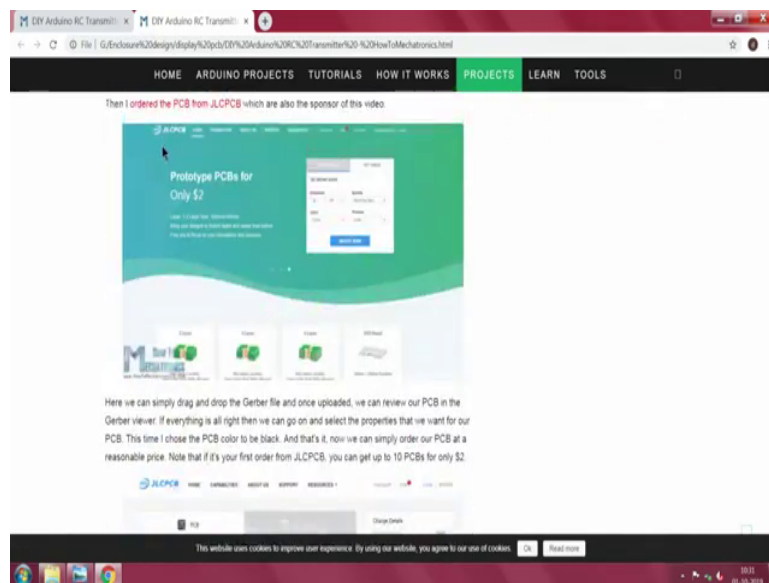
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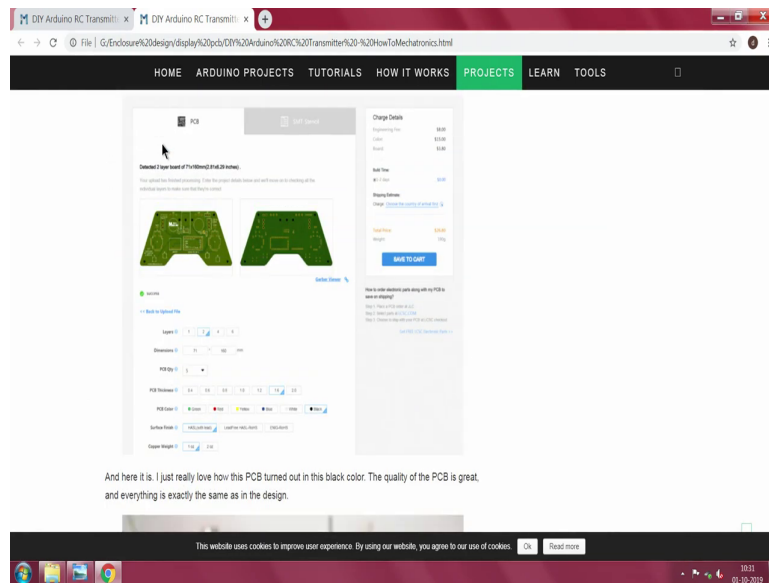
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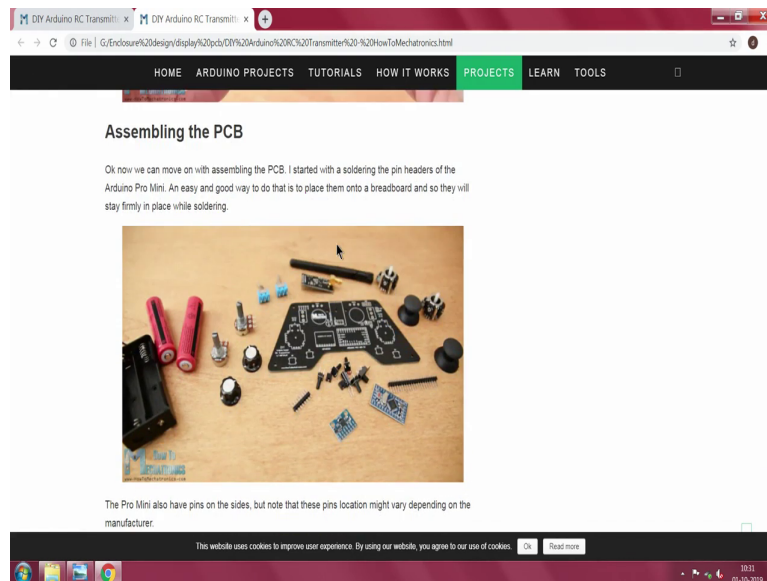
So, there are some you know saying how to layout at and all that finally, at this moment let me say it is just of the PCB is ready, I will not go beyond that though I have use the concept saying it is a printed wiring board. It is not so much as a circuit because a circuit itself refers to now; we have devices which we can be build directly into the substrate.

So, there the circuit becomes what equal embedded in this. In this case it just a connection board. Now, if you see carefully here know, you see here we have 2 potentiometers some knobs and these are the joysticks. And then you have something else also here you have seen this, there is a small connector and then there is a antenna for this.

And this is probably the main chip because you can even see a crystal and then important thing once again is, something which we love to hit power supply and we end up with monstrous

batteries and then there is a battery holder. If you want these batteries to be changed, you need to have a battery holder else, you need to build it into this.

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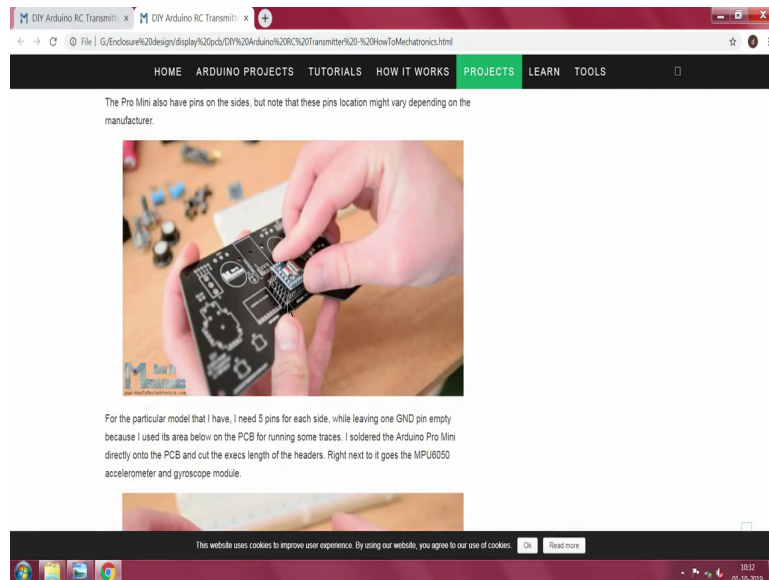
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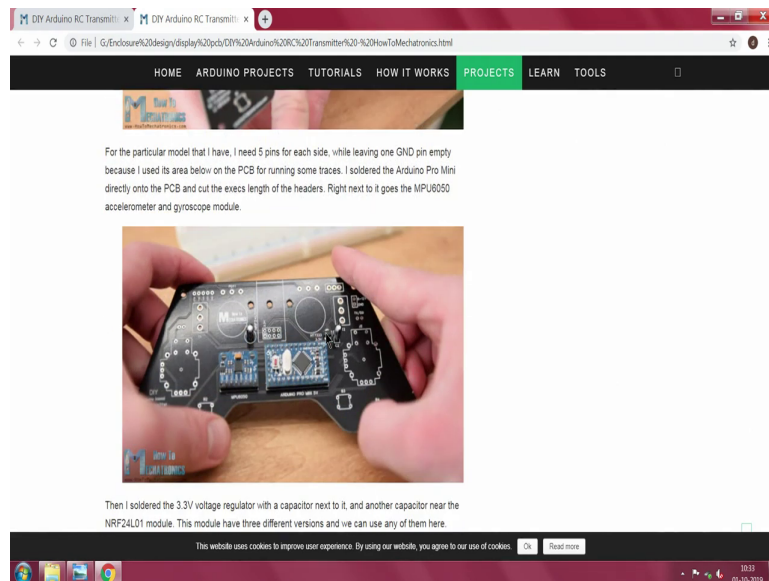
Now, you see here there they have given here we need to insert one of this subassemblies and get the thing ready. This is you know partly ready.

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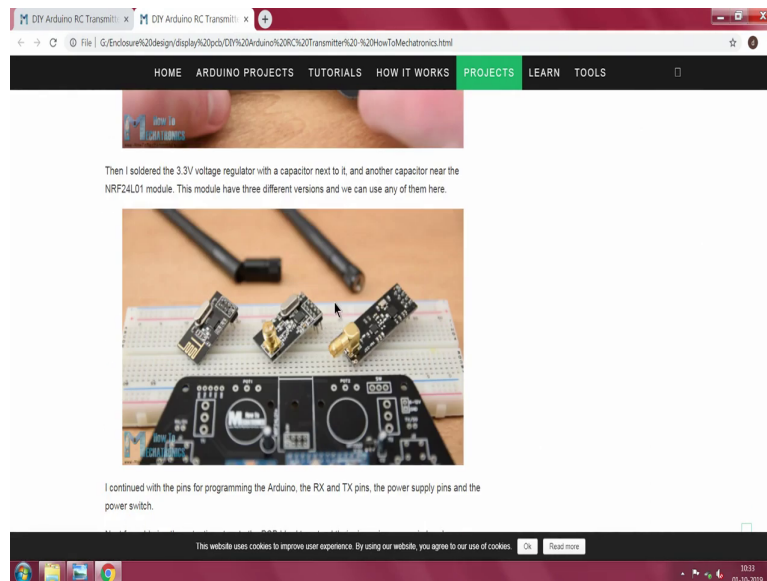
So, we see here that is a, what we call one of them is regulator thing and then after that we have a capacitor then we have the near the module and so on here, now all these things sometimes come after the first iteration.

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So, this of course, it is a matter of detail saying you know, how do you put things there and so on. And then, you see here the most important thing here is the equivalent to a joystick. And then we have a push buttons, which are required for other controls. So, eventually everything is ready. Now comes the other thing for the first time when you want to try, what you would like to do properly is saying is it possible for us to put a cover on that ok.

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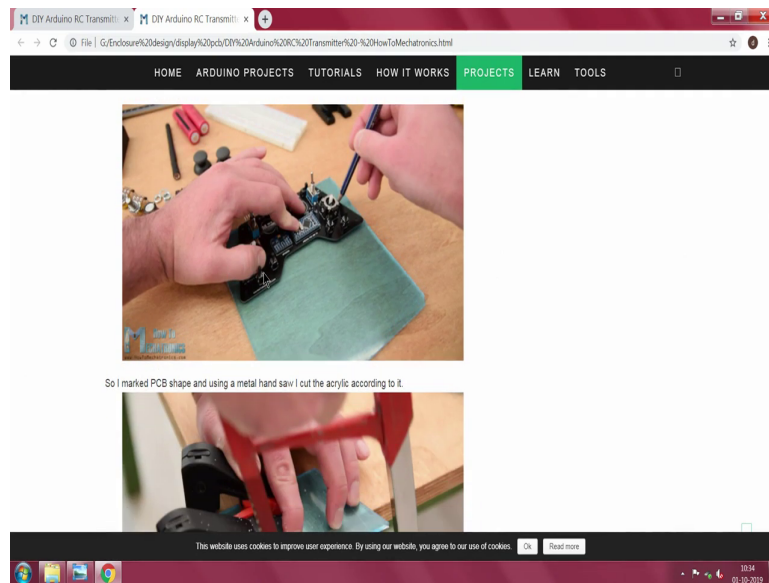
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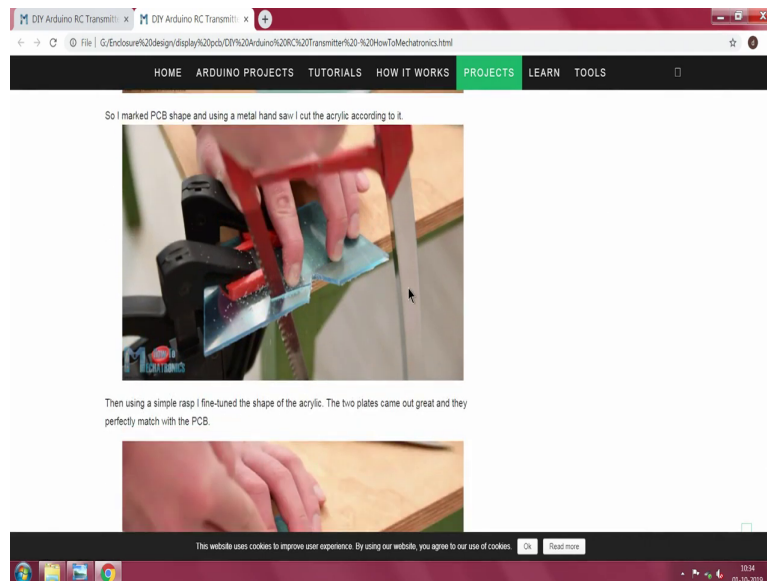
For various practical purposes for you to do the first iteration, what this people have done is he is now showing you how to trace the printed circuit board directly on the into a transparent shape.

So, in this case it looks like it is one of those PMMA acrylic sheets. So, it just he is tooking a he is taking a what a call felt pen.

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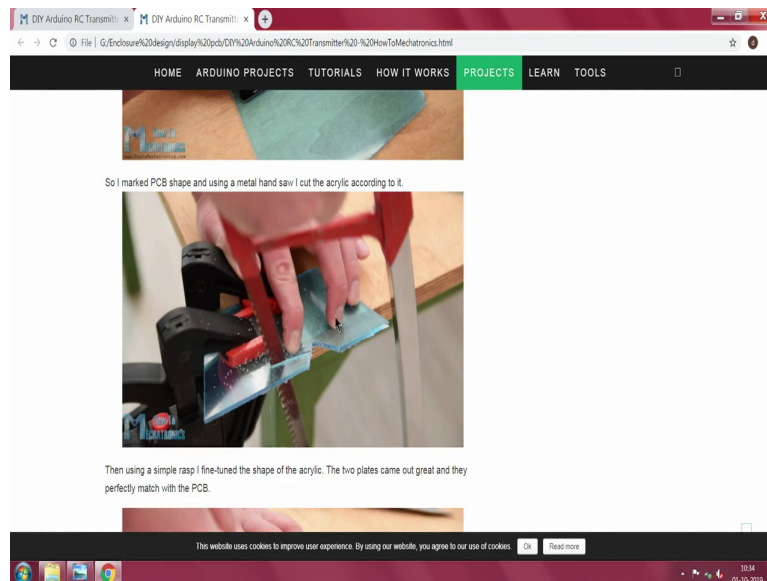
And you see what he is doing? He is just taking a small plates there is a small plates and eventually filing it off. Why I have shown you this is, as of now even today probably this is how things are done, at the first iteration it is not worth directly going away for a very sophisticated, rapid prototyping what you call full-fledged setup, you see here even transferring the holes and then you see, this is where know the critical part of it comes.

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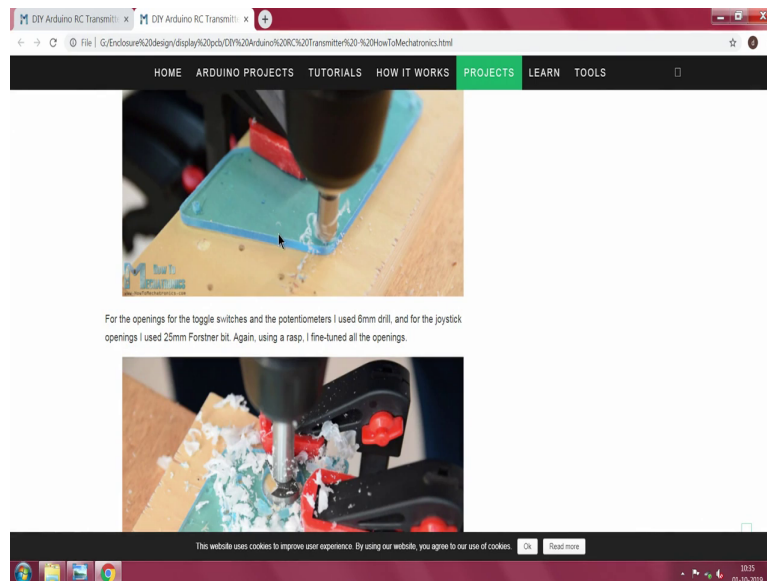
If we had followed as scheme which I am going to suggest, we could have probably avoided this step. Saying, directly when you made the printed circuit board layout, there is something called a DX of file that can be extracted from this? You see here a DX of file can be extracted.

And when you extracted DX file, you see this round circular outline, and then you say we have round circular outline they have this switches all this things, can directly be printed to scale. Why I chose this is you can probably avoid taking this partly assembled printed wiring board, and unnecessarily spending time on it.

So, for illustrative example this is could I am not saying this is the wrong way of doing it this in fact, it is an extremely good way of doing it because, it shows how things are built. But, in

your case what I suggest is, after you make this printed wiring board, you say this there generally a component outline marking ok, legend marking layer, a print.

You can probably extract DX of file from here and get the outline and if you print all of them in your printer to a scale same scale. Generally, there is not a big problem plus or minus 0.2 millimeters we can go ahead and cut the things. So, that this whole thing about you have seen this know, this part about tracing it and trying it to you know you understand know this part of it can be avoided. But, then there is no issue about it all.

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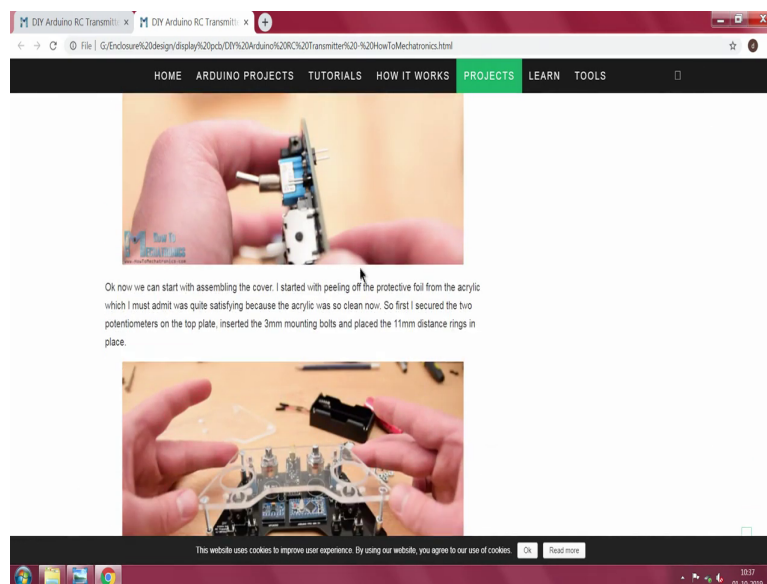
And then you see this is we could have directly jump to this layer, and you see here where coming to how to assemble a acrylic cover on top of it, it is very easy. And this is where you know probably your creativity and learning by not by trial and error improving on what has been done earlier.

You will notice here that this while acrylic is insulated, there are its alarming to see conductive screws everywhere, because unwittingly we may go and place a conductive spacer on top of it. So, while making the layout it can be made into island zones which should not be extended upon or if it is going to be tied, you should remember to put an insulating washer.

So, you get washers in all materials where you loosely something called the; what you call various types of phenolic washers are available. And you just have to select a proper one and the only disadvantages often, those spacers and washers may extend beyond the board outline.

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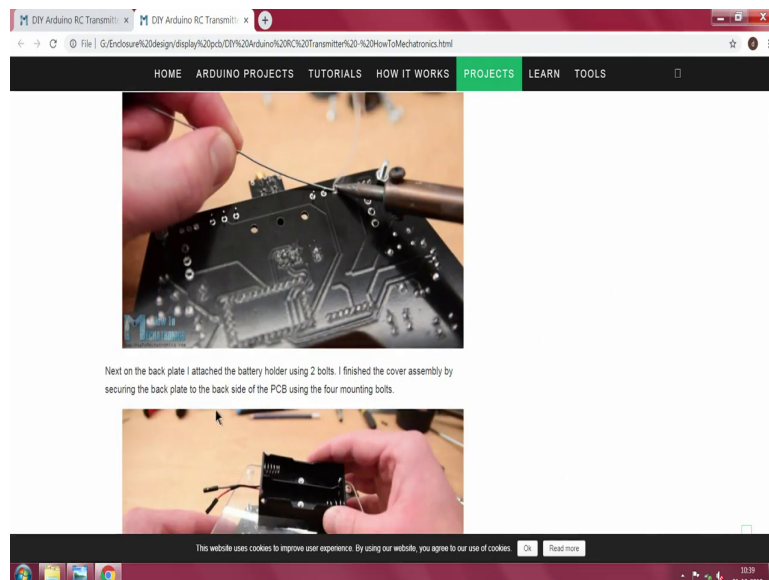
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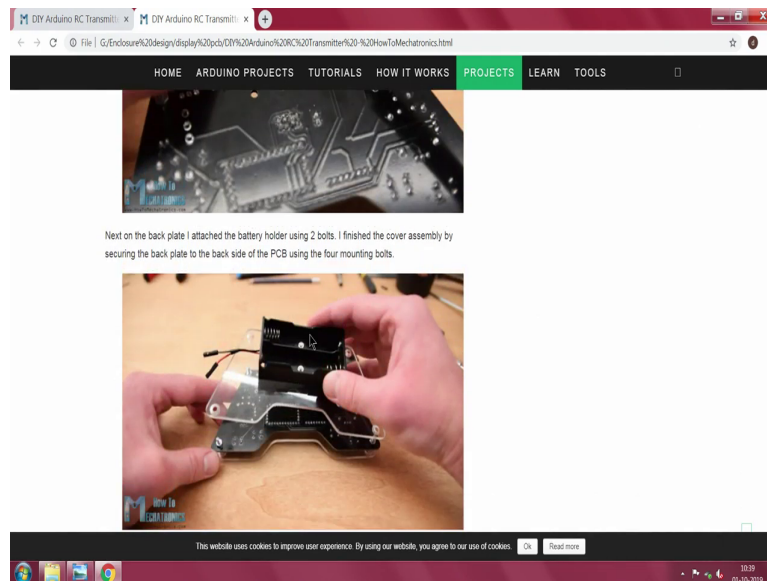
So, here they have shown something you know, again I told you know the irritating part of it is the power supply. There is no simple way of getting rid of the power supply.

However, in the second round when we make it, it is very much possible probably to replace this whole thing with a single flat lithium polymer pack. Typically lithium polymer packs are small and it is very much possible for us to look for the proper thing and only thing is you have to be careful on, how will you try to charge them.

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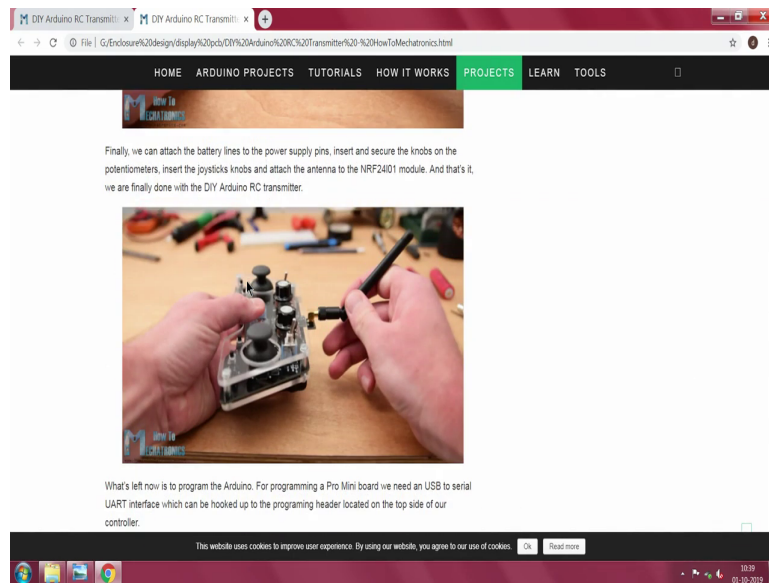
So, you see here after finishing this, see here one more nice interesting thing, this is the RF portion of it.
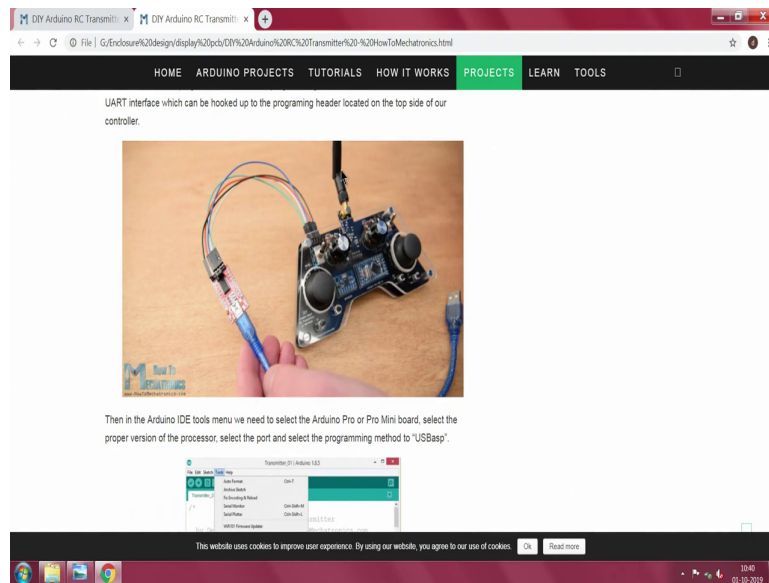
So, we have a antenna here and there is something called a programming header here. This programming header through all this you know we need to finally, load all this things and your project is ready my of course, I am not going to you know talk about this things, but you see here that you are seen here, its looks like this runs this small I do not know, what I call it just you know trial device and then all the other things are explained here saying two joysticks.

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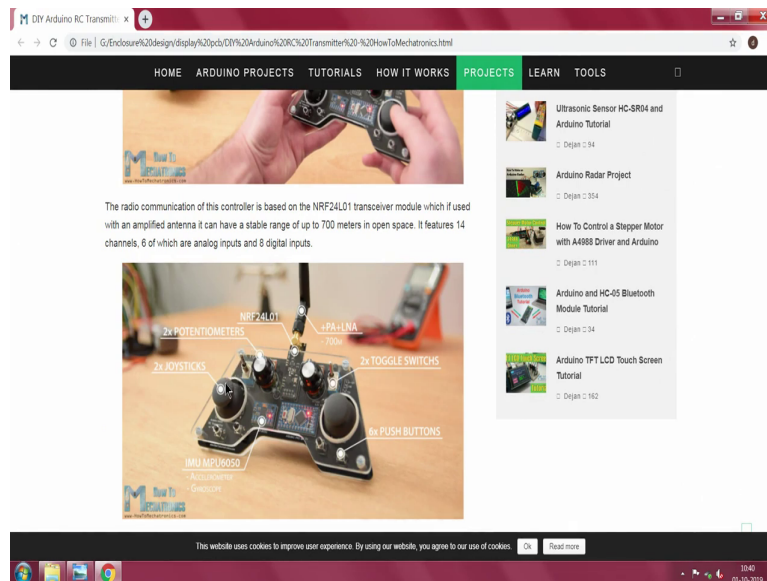
And we have a 2 potentiometers then there several toggle switches, then we have a accelerometer then we have the transmitter and then we have the amplifier plus these things.

So, in the end, what started here? We have a fully working PCB. I thought, I will just stop it here and try to go back to our thing what we can do.

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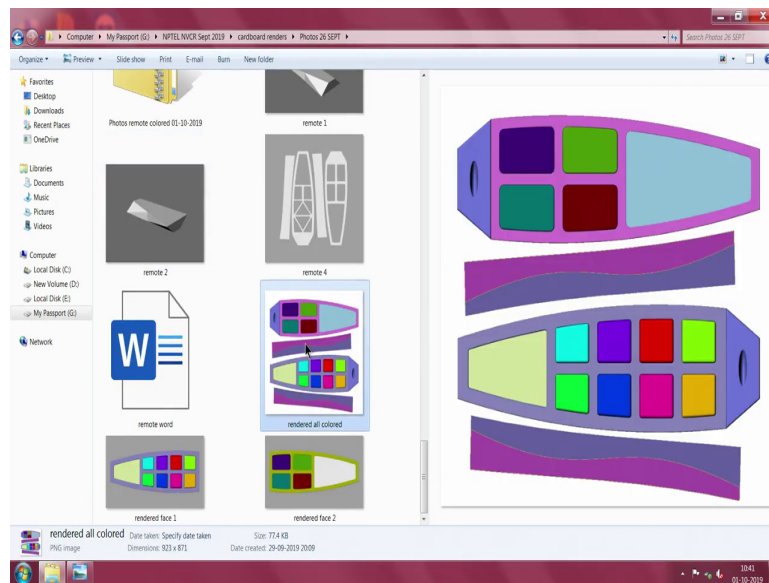
Perhaps you remember yesterday let me locate. Yes, I have started with a what I thought was a very exotic and beautiful remote controller and the whole thing has been I do not know which program anything else there, but this particular coloring and all these things you know were done on a free Autodesk Pixlr editor. Because the colors come vivid and it is very interesting and nice to say them, say if a little closer.

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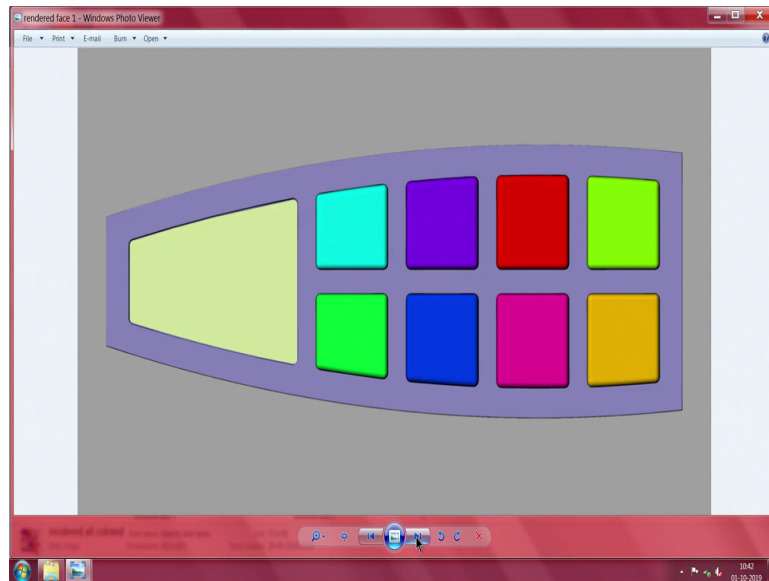
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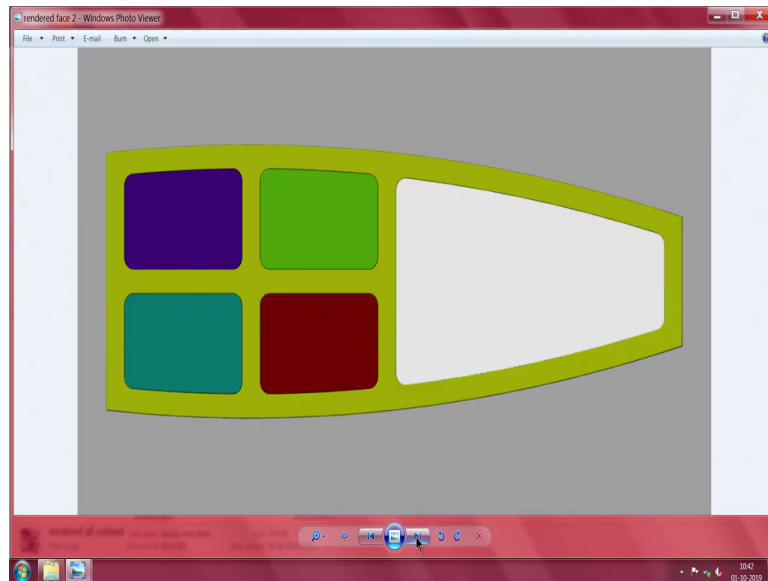
Its exotic just for the fun of it, I have randomly picked one side of the remote is suppose to look like this. The other side of the remote instead of this 8 buttons this has only 4 buttons, it suppose to look like that. It all if you remember you know it all started here.

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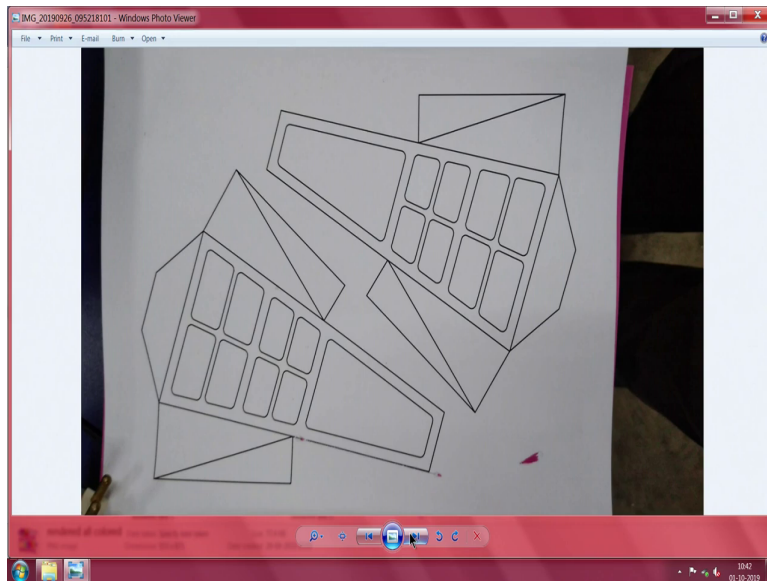
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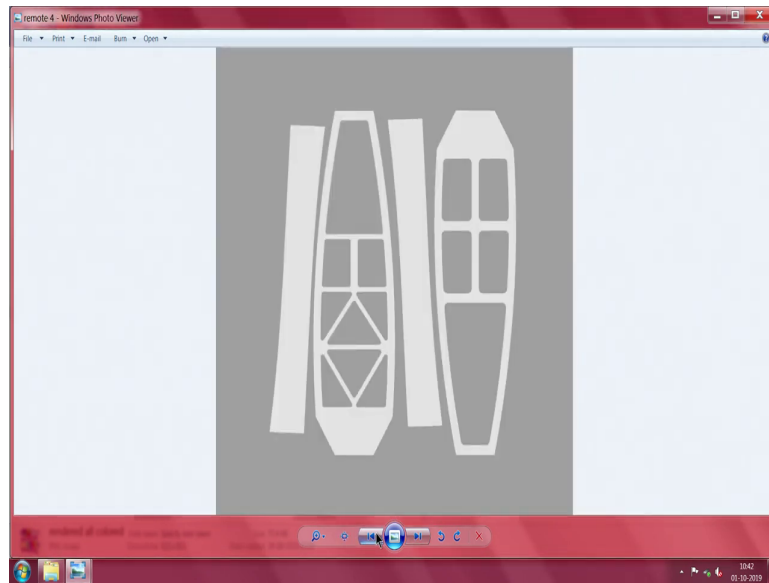
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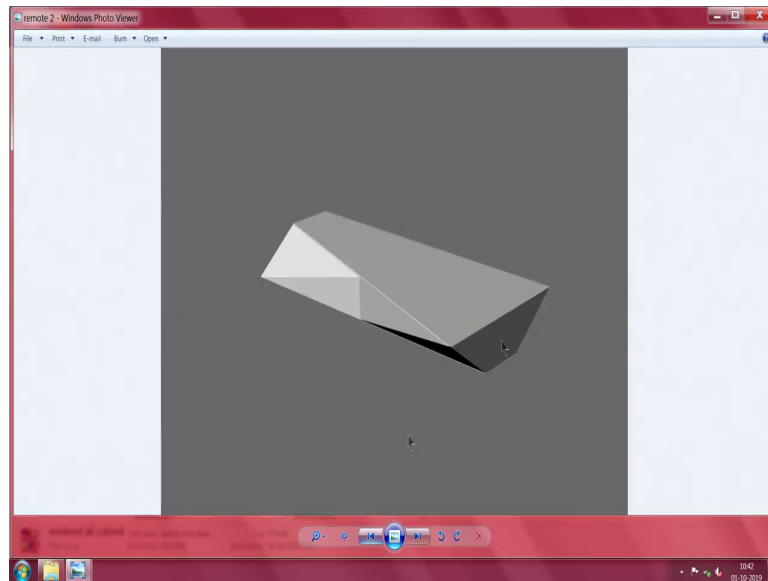
And then eventually other variants are also worked out. Why? As trying to show you this is now you see here in case you want you add any meaningful graphics and key; what you call designations, you can use any of the existing tools which are available for you. All you probably need is a I mean any old laptop and then you come here you beautifully have, you can add as I said this only a not a great (Refer Time: 16:33) this thing, it is not I am not; this is not going to talked you about how to make a any meaningful product its more to do with, what is just lying around.

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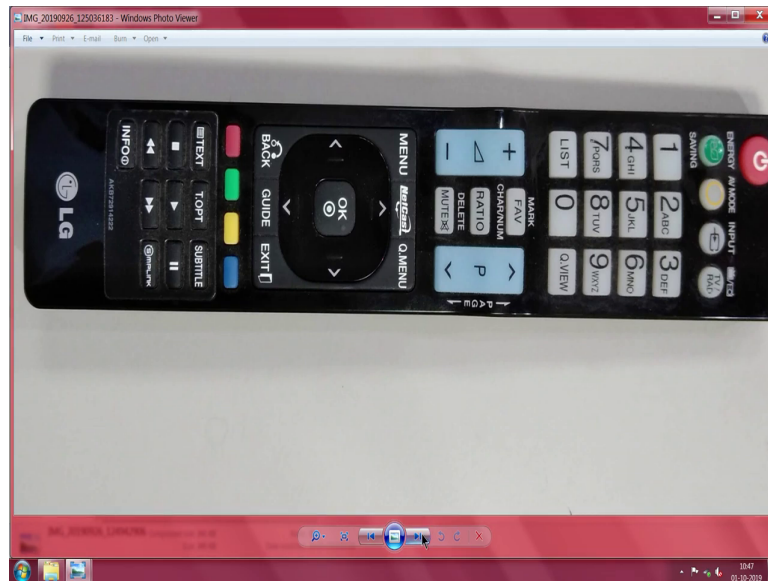
You see this, this remote is the one that has been picked up from the our thing what we have here. See this it still is complicated, very complicated ok.

Now, they call it universal, I will just show you I will just bring it from there and just show you. It is complicated, have you noticed? Now, there too many things, there just too many switches and I really do not know all I have here is a huge monitor. In fact, it is a monitor wall and I there not press anything here. For one of the things simply it says video source.

If I mistake, if I press the video source, finish all my picture is gone and I cannot get back at all. Because, I have to probably scroll through to what you call RCA inputs and then two HDMI inputs plus we have a satellite link plus we have a regular cable and likely this does not

have often there is also a small, what you call optical link also. So, this is for too complicated to be of any practical use.

Now, if you look at my presentation see here. May be what are all those buttons doing there? I am not very sure what the buttons are doing there, too complicated. Seen this and there is something I do not even know, what it means and there is something which I am not sure, what are all the functions which are there like that, hence my think saying, why do not I make a simpler remote control, this is where when started this.

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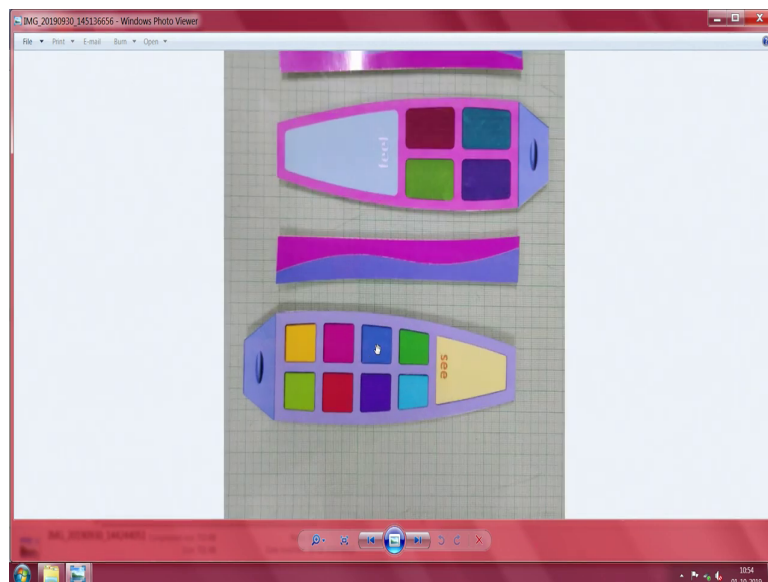
My colleague was a professional artist and model maker. He is just trying to demonstrate. What has been done is we have just taken a print out of the that device which I have shown you and just kept it on a flat sheet, of course, he has that special cutting sheets and there we are, and the next one.

So, you see here my colleague nicely laid out everything and he used a where possible, he has used a straight edge and all the straight curves are done here, after that he has just used what you call X-Acto or art knife cut all around and then you have there, this beautiful thing getting ready, you have see here.

And the only disadvantage here at this point is where we I have learnt by hard error this particular photo paper which I have picked (Refer Time: 21:10) stiff enough. And there is no way we could you know what you call attached cardboard and all that. So, it looked a little flimsy.

Now, this is where the actual critical things come. Have you seen here at the back we have a graph sheet this one is a millimeter graph. So, I have intentionally I have what you call aligned it to one side. Now, I can just count all the what you call various items and see how accurate it is towards my the original concept which I have taught about. Why this is required is, we have this issue of should we make it top down or inside out approach.

In the case of a top down we just make the what you call this whole concept as we expected to be and in the case of the bottoms up approach we have a standard what you call component layout, probably, which is a reference design which is supplied by the manufacture.

So, something in between by which you probably need to make a layout and make all this things, we come to all this things, can you see here. One side of my concept compare to the earlier remote control, one side is going to fully concentrate about in a room, the display what we have. In the case of the display it can be a television set or it can be an over head projector or now these days so, many more items are there.

So, one of the easiest thing you can think about is, probably you have seen the Apple TV box or you have seen the various type of cast devices. One of the early cast devices probably Chromecast, then you also have Amazon Fire Stick and so many other variants.

So, this particular what you call remote we will control all those thing. Hence, all these buttons, what does these buttons do? You have to assign them. You decide whether one of them is for the what you call devices which will take care of the input of your display, and I said that display can be very simple display like a TV or it can be a thing, which students often use like we have a projector and you have a power point presentation which is there.

So, this when I say see control can be handed over to that then, this is where my colleague is now trying to what you call assemble the device as we expected to be assembled. Of course, there was an error, everything does not well you know work well the first time. So, that is how they we have you know Bespoke shoes, tailored cloths and then designer everything.

So, you see here there are some unwanted spaces here, while at one level it looks fine, to get it in to the shapes till takes a little bit of work. So, you have here a full fledged what you call remote in one side you can say what it is, the other side it shows the feel you have in your room. In this case the feel can be the ambient temperature control, typically the heating or the cooling.

Or these days we also have the lighting, you can have lighting change color and so on. And a little related to do it is the music and various types of things, which you do not need to look at it, you can do some other activity and you just have a proper ambient, instead of calling it ambient; I have just roughly called it there. So the other side of the PCB is see something and this side of the, what you call my remote is something to do with how it feels to have the remote.

So, I will now stop here and try to get back to where I had started earlier, this what I was looking for. This is the printed wiring board from the that schematic which I have shown you ok, let me put it the rendered module which I showed you. Now, we come to this, so we start here and go up or we start there and go up. In my case; obviously, both are important.

Since this is a fairly standardized unit, it not impossible for us to put all these things where we want. So, you see the other side of the; I think I will add it later. So, the if you see the other

side of the printed wiring board, we have the various types of tracks and we can just rearrange everything. You see here at one side you probably have on the other side of this, I am not able to locate the picture, you have the tracks meant for various types of just like in this picture, if you remember we had the display then you have these are the key pads.

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So, you can now in fact, probably do a cut and paste job and make a PCB layout based on the outside the model which I have made. Which I feel it is a very useful and slightly different way of making things compare to earlier way of doing, what you call things in a got it here, you have a look at this.

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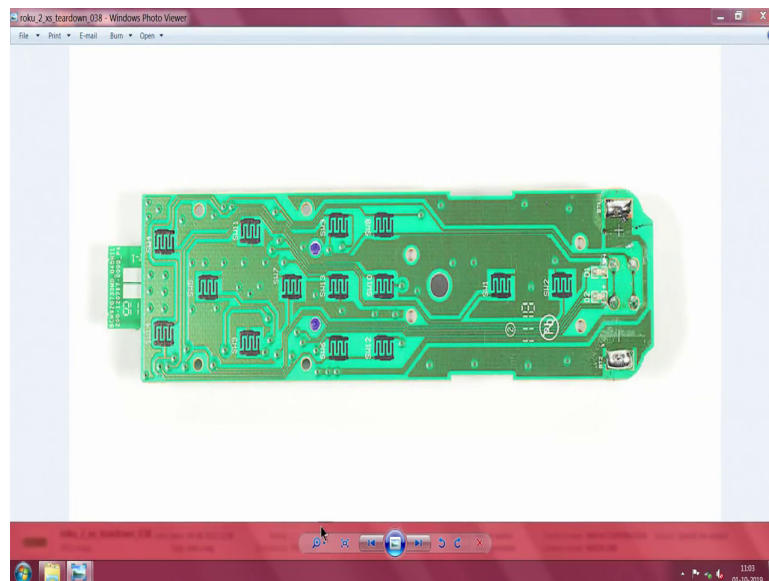
You have seen here on the other side these are all the keys. So, probably you can take one of these traces from here and probably copy those, what you call the tracks which we have the, what you call plus and I am sorry high and low what you call tracks. And then place them wherever you want directly under the layout of the cardboard remote, which I have shown you.

So, in that you have here probably this one goes to the infrared LED on the other side. While this other case and all are you know I do not know how where they come and what is the thing you see here finally, I got it here.

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Somebody has opened what looks like a we have a beautiful remote, which is suppose to join together, I do not actually know about the what you call the devices, but I have here nice wiring board and circuit board which goes into this enclosure. And you will also notice that there is a opening and on the side there is one more they call input, output board.

And on this side, we have the important thing saying we have 2 keys, then you have place for 2 batteries and then I mean two shells to make a battery. And then you have the whole they call your construction ready.

So, my suggestion is that one is a readymade of the shelf part of some system somebody has bought but if you were to make it and you want to avoid getting into multiple things which are not that useful, this we have seen earlier.

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We can, where we can avoid all these things we should follow that sequence or start with a reasonable layout, get gather all information about the components and take a graph sheet arrange all the various components on the graph sheet. And in case you do not have components if you have been seeing my earlier pictures, one of the things you will notice is that the outline mechanical drawings are available everywhere.

So, you make decals to scale. As I said usually there will be a tabular column in one corner, which will tell you what is the height what is the mounting and all that make a decal which is exactly representing that. Now, you can play around all this like a jigsaw puzzles, try various options and whatever is best that can be done at that point.

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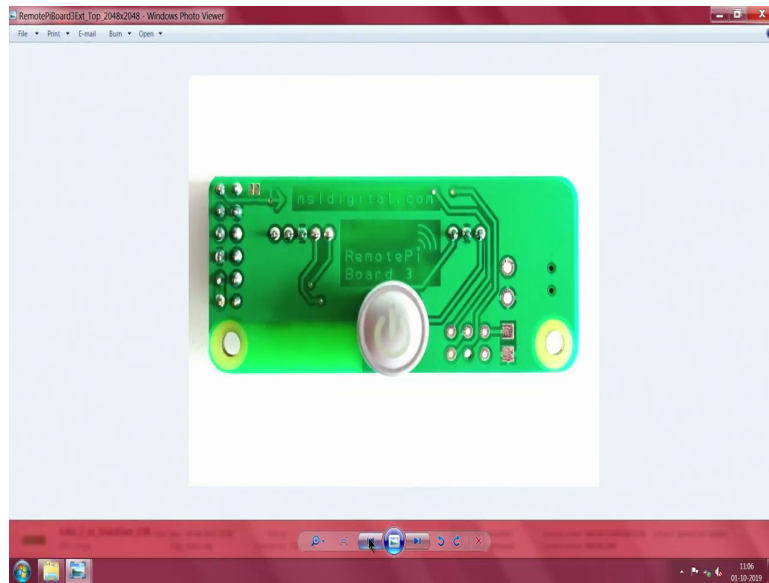
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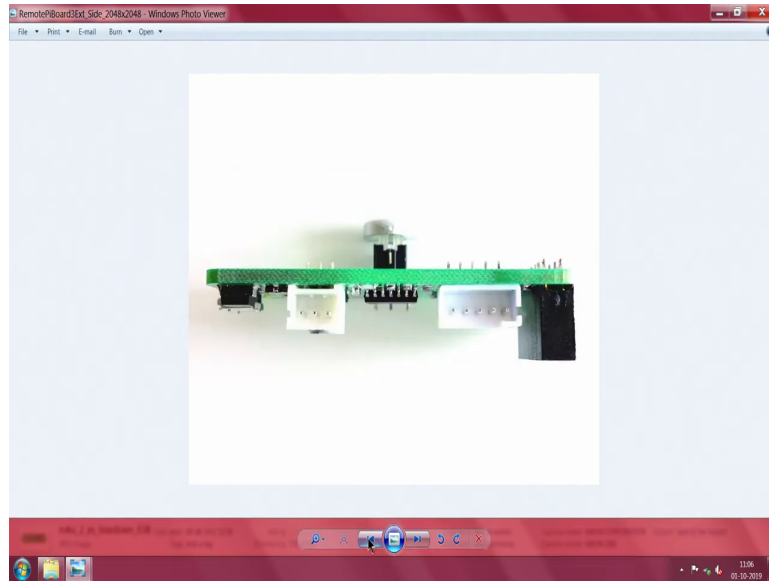
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You can always attach it to them and get your beautiful bold ready, without any problem you will have things like this. You see here; obviously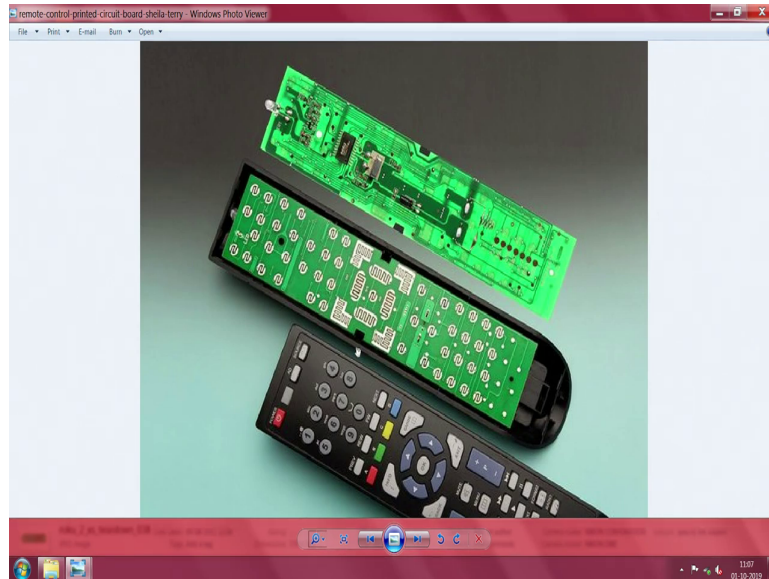, it has gone through several iteration. This is from the remote control or equivalent remote control what I have shown you.

Now these are the 2 sides of the printed circuit board. On the top side, for every button here you will see there is a corresponding pad here, contact pad. And usually, in the earlier technology there used to be a button in which there used to be a conductive pad.

So, this conductive pad goes and sits on top of it, it makes a connection. The only thing what I want you tell you is a general purpose device like this first of all is cheap and very good, but however, a little confusing for the user. Now you can always make something on your own, use all this, whatever you can and then use all this see, whichever functions are most useful for us, and try to build on these things.

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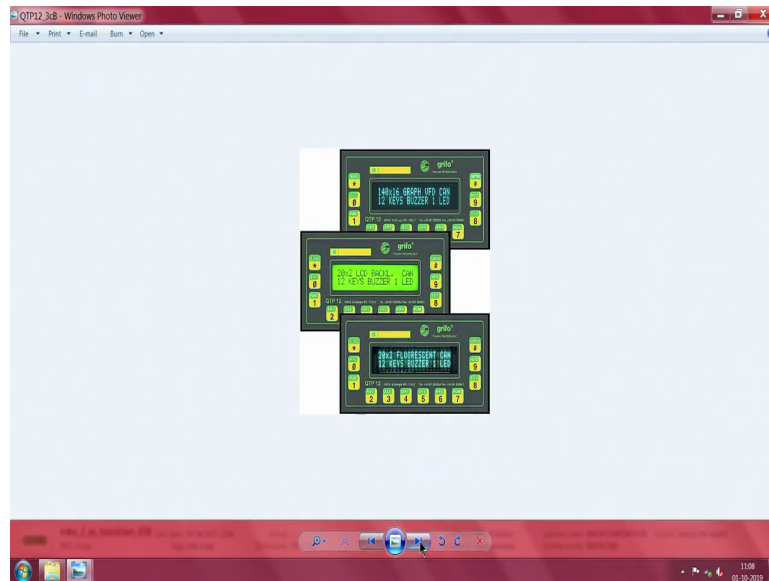
So, I will stop here and we will continue again next time with a actually little more of a physical example. So far, I have cover 2 things, one is saying, how to use the printer which you have at home and make nice prints as per some concept which you will like to have. And I have shown you what is a; you know somewhat possible unit which can be used in real life. So, we will meet again in the next lecture, hope you will look around a various things you have in the house said like to have. One of the starting things are for example, that remote control what you have for the TV, I think it is not correct to disturb it, just leave it there.

However, you have to have ambient control like you know you have the air conditioner that is cooler and heater then you probably have a remote fan. Then you have lights all around the house and then, often you have probably have a small device which is an a FM Radio or some audio device in which you can get music.

So, imagine a product which you would like to make, a small remote control which other than the TV, you are just lying around and you can do everything else in the house. Except of course, meddle with the things in the kitchen, it will not be a great thing if you block the kitchen.

So, generally it is very rare for the kitchen gadgets to have any of this remotes except, the chimney and these days some of the chimneys are also built along with the microwave, we just sits on top of the hob, we have a hob and top of it you have a microwave which incidentally is the chimney and it has both options; recyclates and it also exhaust plus you have lighting on top of it. Why did they make it? I have no reason, but that it is very popular in all the cooler climates.

Probably it also helps in you know saving a little bit of heat and in case you want to have a keep warm function it is good. Some of those devices do come with a remote by which you can you know make the noise less, you can switch on the lights and probably you know start the microwave carousel, but it does not allow the main baking or grilling function via the remote, that you have to do by hand.

And then basically you have the cooking range, so you have a gas range or you can have a various types of ceramic short glass range or anything usually underneath that directly you have a huge oven. So, in those ovens they try to make the other things. So, concentrate on making that, making a think about a small remote which you use for controlling things around the house other than the TV. So, thank you. I will stop here. We will try to continue the next time.

Thank you.