Embedded System Design with ARM
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Lecture – 22
Interfacing with 7-Segment LED and LCD Displays (Part I)

Welcome to lecture 22, in this lecture we will be Interfacing 7 Segment LED and we will be interfacing an LCD displays. We have already discussed about what is a 7 segment display, what is an LCD, how it works in this particular. And, we have already discussed about the 2 boards, how will how you will be interfacing with Arduino board and with STM board. In this particular lecture, I will be showing you the circuit diagram and the code that is required for interfacing the 7 segment display and the LCD ok.

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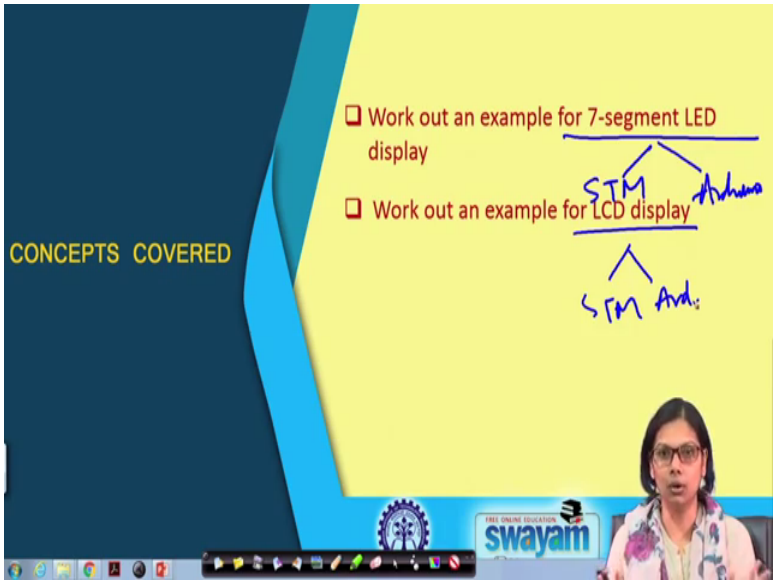

So I will be showing you an workout example of a 7 segment display and also I will be showing you an workout example of an LCD display. And make sure that I will be showing this one for 7 segment display both using STM board, the circuit diagram as well with Arduino and also the same thing, I will be doing for STM and Arduino. So, this is how this lecture will go on ok.

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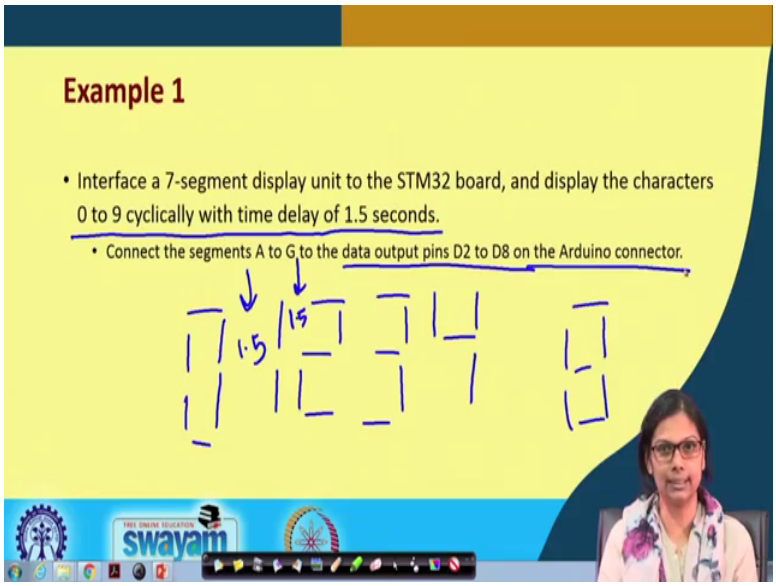

The first example that I will be showing with 7 segment display unit to the STM 32 board and display the characters from 0 to 9 in a cyclic fashion with a time delay of 1.5 second ok. So, what will happen that, we already know our 7 segment looks like what it works. So, what it will do is like that, it will display first let us say, it will display 0, this is 0 then it will display 1 then it will display 2, then it will display 3 and so on ok. It will go on doing this with a delay of here, there will be a delay of 1.5 second, again there will be a delay of between 1 and 2 1.5 second and so on ok. And I will be connecting this from segment A to G of the data output pins D2 to D8 on the Arduino connector using this STM board.

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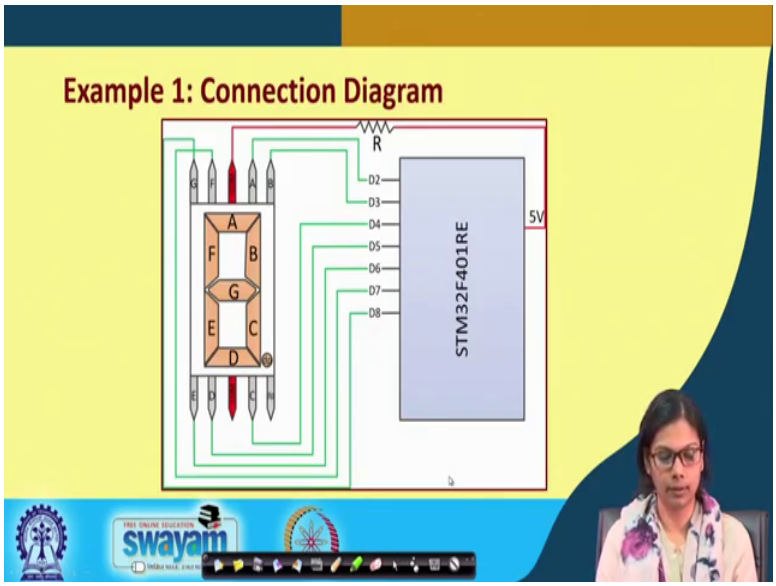

Now, this is the typical circuit diagram that is there you can see this is the common port. Now, this is a common anode 7 segment, we already discussed about common anode 7 segment and common cathode 7 segment. This is a common anode 7 segment where, the common port is connected through a resistance to 5 volt of STM and all other ports that is A, B, C, D, E, F, G and dp these are connected to pin D2 to D8 of this STM board ok.

So now, you can see the connection A is connected to D2, A is connected to D2, B is connected to D3, C is connected to D4, D is connected to D5, E is connected to D6, G is connected to sorry, F is connected to D7 and G is connected to your D8 ok. This is how we have made the connection, there is no hard and fast rule that you have to make the same connection, but this is how we have connected it ok. So, this is all about the connections.

So, when you have this 7 segment with you and you want to connect it you connect the common, if it is a common anode 7 segment, through the common points through a resistance connected to 5 volt. And all these points, you connect to the ports of your STM.

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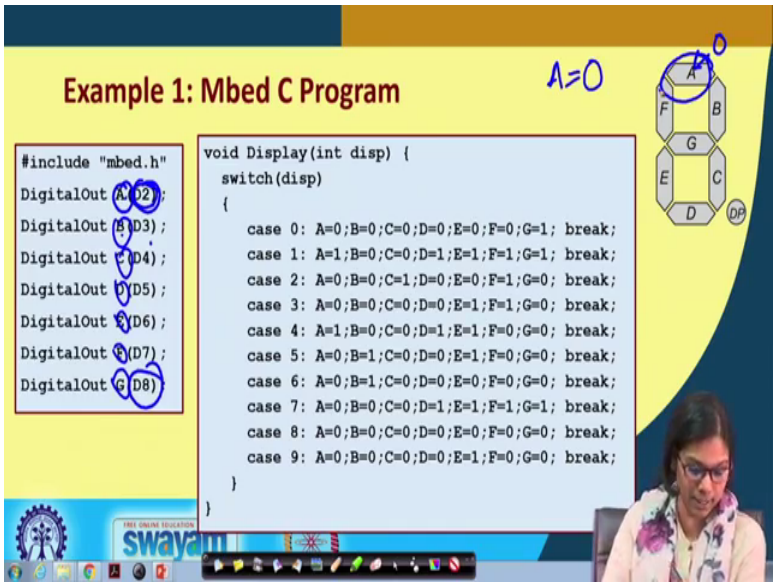

Now, let us see the Mbed C code. Similarly as I have told you, we have made a available pins D2 till D8 starting from the segments that are connected that is A, B, C, D, E, F and G and in the same way, we have given these names also for the digital output port. So, which is A which is connected to D2, B is connected to D3 and so on.

Now, it is a common anode segment; when this segment will glow? The common point is connected to BCC, this segment will glow when we pass a 0 value to this line. So, you have to pass in D2 through this A, A is the signal you have to pass a 0 then only this particular segment will glow, this is A segment, when this segment will glow this segment will glow, when you pass a 0 to this. So, to glow it you need to pass a 0, because it is a common anode, if it is a common cathode, you have to do the opposite one ok.

Now, there are 9 cases because, I have told you, I will be displaying from 0 till 9 with a delay ok. Let us first consider case, 0 what is 0? This is 0, this, this, this, this, this, this. Now you see how many segments will glow, all the segments except G. So, only the G segments will have value 1 and all other segments, you want to glow, you have to pass a value 0. Similarly that is what I have done A0, B0, C0, D0, E0, F0, but G is 1 ok.

Similarly, for 1 for 1, it is interesting you see for 1, you only need B and C to glow. So, B and C should have a 0 value all else will have 1 value, you see B and C is having 0 and all others are having 1. So, you can do that for all others ok. I have shown you for 0 and 1 similarly, you can try out with 2 to 9, it will be somewhat similar. So, this is the code

that you have to write here digital out and this is the switch, now we will see what happens in the main in the main phase of the program.

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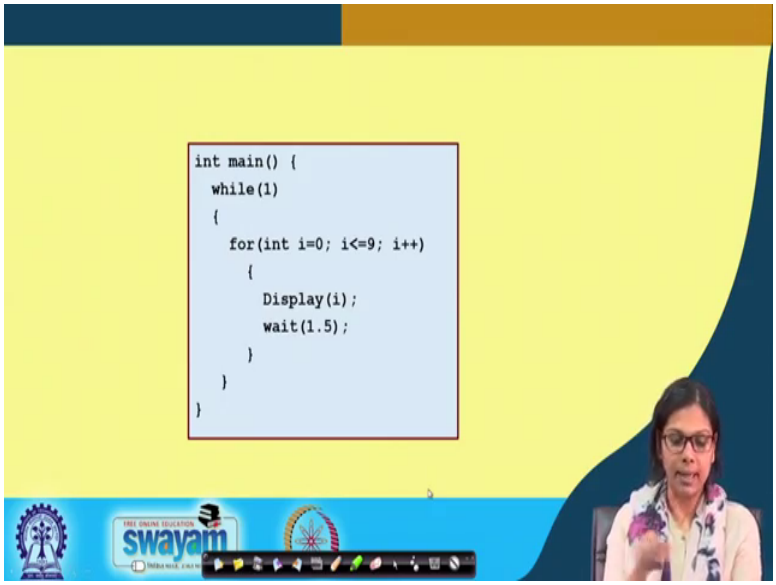

In while one way what we are doing for i equals to 0 sorry. Here what we are doing for i equals to 0, i less than equals to 9 i plus plus, I am starting from 0 till 9 and when it becomes 9, it will be again in this particular loop, again it will become 0 and I am calling display of i, when you call display of i, it will go back to where it will go back? It will go back to here and it will check this, it will actually go back to the previous one ok.

Here it will go back and it will check for this case k 0 and it will take this output and then it will break and it will wait after that for 1.5 seconds and again it will do the next one. So, what it will do it will starting from 0, it will go on doing 0, 1, 2, 3 up till 9 and many reaches 9 again it will become 0. So, this is what it is doing, this display I am sending this i from 0 till 9 and again after displaying, it is waiting for 1.5 seconds again, we are displaying it. So, it goes in a continuous loop.

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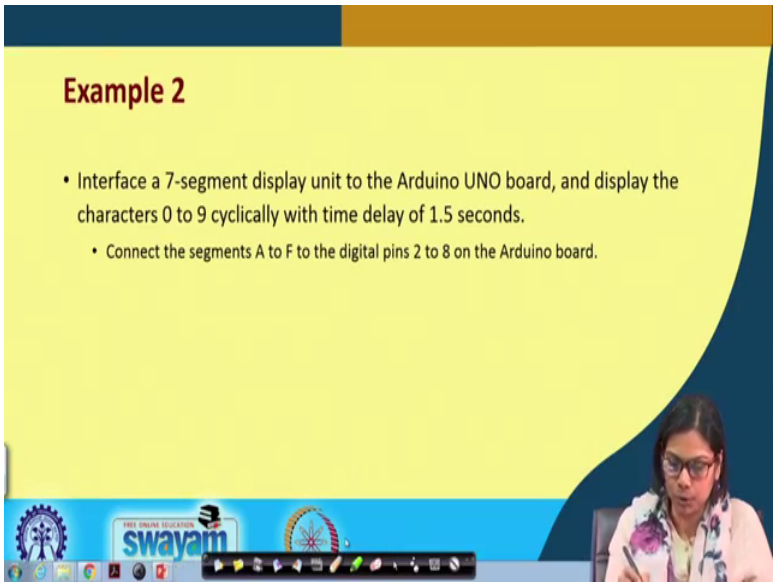

The next example is very similar, but with Arduino board ok. So, the previous example that we did is with STM board, this is with Arduino board things are pretty similar, but the only thing is that the code part will be little bit different from your STM ok. You have to again connect from segment here from a till F till G and digital pins D2 to D8 on the Arduino board.

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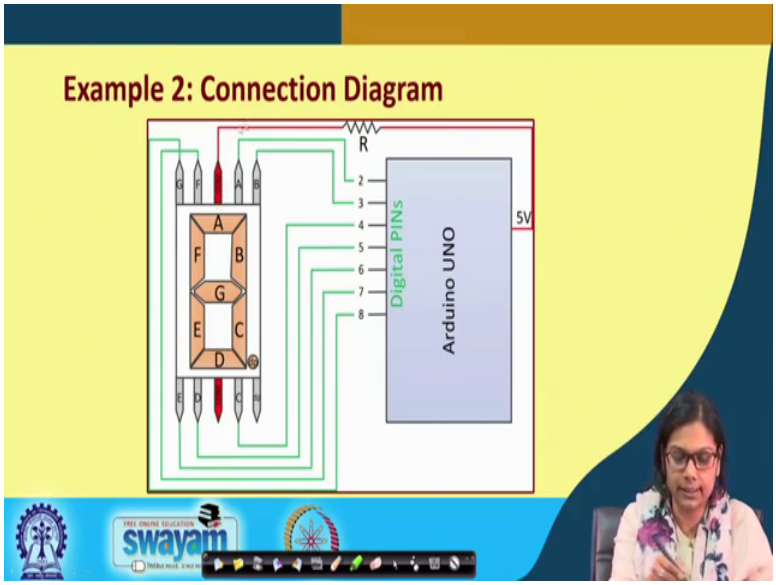

Let us see the circuit diagram again, the circuit diagram will be the same the common port of the 7 segment through a resistor will be connected with 5 volt of the Arduino

UNO board and digital pin 2 to pin 8 will be similarly connect from A, B up till F oh sorry, up till G in this particular board ok. The same the way we connected for STM the connection for this will be the same.

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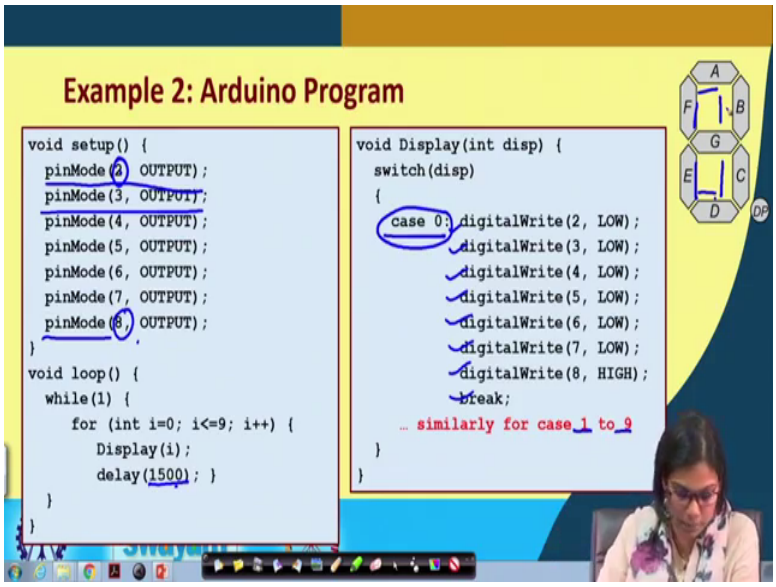

Now, see the code here similarly, we have in the setup phase, we have to specify the pin mode for each one of the pins, we are using pin 2 to pin 8. So, we have to specify the pin mode of each one of this and each one of this are all output. So, we are making all the pins starting from 2 till 8 as output and in the loop phase, what we are doing? We are doing something very similar.

So, let us say for i equals to 0 i less than equals to n i plus plus, I am again displaying i with a delay of 1.5 second, which is 1500 here. But here for case 0 in STM, we have seen that we have only written A equals to 0 or A equals to 1, it was working, but here we have to specifically write for all the pins here like this one by one by. So, we have to write these many times the digital write function to write for case 0.

Again for case 0, it will be A, B, C, D, E and F no G. So, you see A, B, C, D, E and F, but not G, G is connected to pin 8. So, it is not it is high ok. Similarly you have to write the same way like, this is just for case 0 for case 1 till case 9. So, for case 1, it will only be this and this. So, it will be low to only B and C, B and C is connected to 3 and 4 and all others it will be high. So, it will be similar for other cases. Now of course, you have seen that writing again and again this digital write so many times is somewhat cumbersome.

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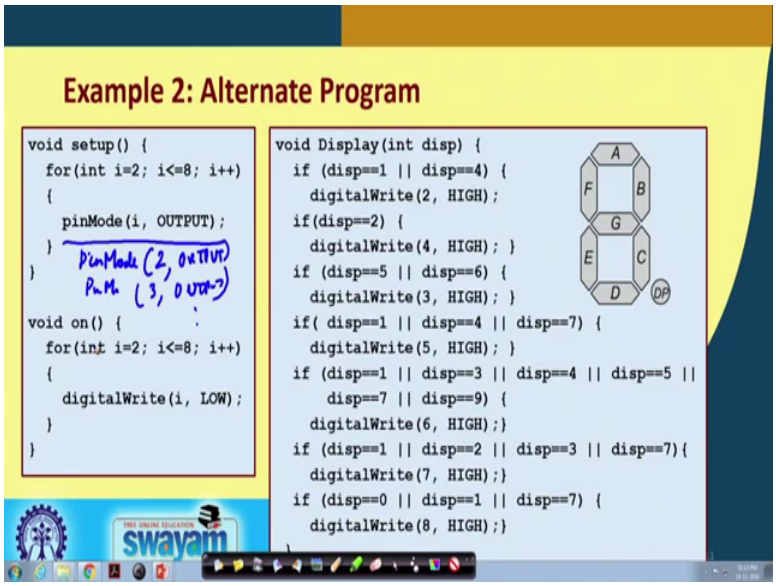

So, an alternate program an efficient and alternate program could be something like this for i equals to 2 to i less than equals to 8 i plus plus pin mode, we are writing i equals 2 output. So, what will happen first time it is 2. So, it will be pin mode 2 comma output ok. Next pin mode, 3 comma output and so on, it will go on till 8 ok. So, in the initializer instead of writing it so many times, we have just put up a code for doing this. Similarly in this on in the on what we are doing for int i equals to 2 i less than equals to 8 i plus plus, we are writing digital write i comma low. So, it will be like if it is for these we are on a first go, we are writing low value to all the pins for all the pins, this is low value that is what we are doing it.

So, we are writing digital write i that is pin 2 low 3 low, all the value we are writing low. Now for display, what we are doing? Display we are checking something, now you see if it is 1 and 4 ok, we are writing value 2 to high, because for 1 basically, it is this and this and if you see this and this and for 4 it is this, this and this ok. So, what basically we are doing if display equals to equals to 1 ok; that means, you want to display this as either this 1 or display equals to equals to 4.

Then we are writing digital write to port 2 as high port 2 is connected to this and we do not want that to glow and as well as for 4 also we do not want that to glow that is why, when it is 1 or 5 then digital write 2 will be high. If it is 2 ok, let us take another one, if it

is 2 this, this, this, this and this, you see if it is 2 then this will not glow and this will not glow ok.

If it is 2 then we are digital writing 4 as high again, if it is 5 and 6 we are writing 3 as high. Similarly again, if it is 1 or 4 or 7 then we are writing 5 as high; similarly for all others. So, here although we are have to check so many condition, but it is not like we have to write it the whole set of codes for all the things. So, this is one of an alternate program, where we have shown another way how you can do that ok. So, we have used the simple, we the previous one for experimentation ok.

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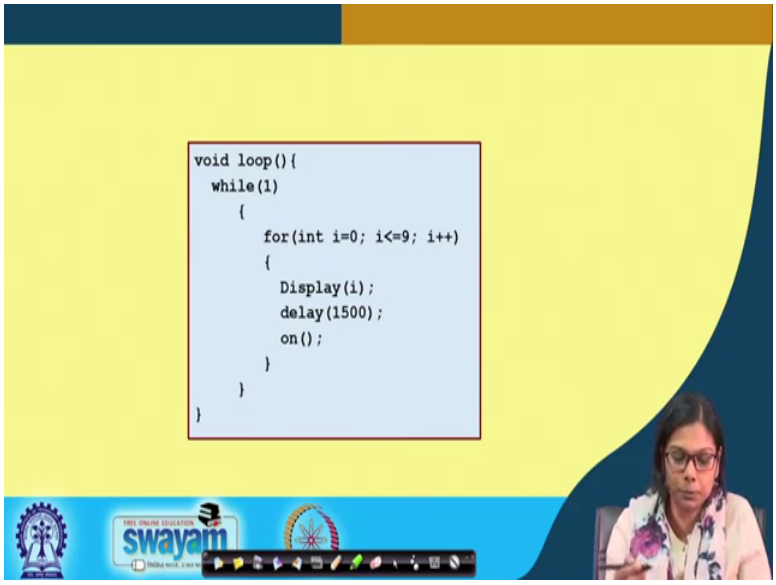

So here, is in the loop section what you have to do while 1 for i equals to 1 i less than 9 i plus plus, we first call display i then we call this delay and then we call this on from sorry, then we call this on function ok, which is doing the required functionality that I have just discussed. Next I will move on and I will be showing how we can interface the LCD ok. The LCD has been already discussed in detail, how it works. Now, I will be just showing you again, the circuit diagram and the code that we have used both for Arduino and for STM to dump it ok.

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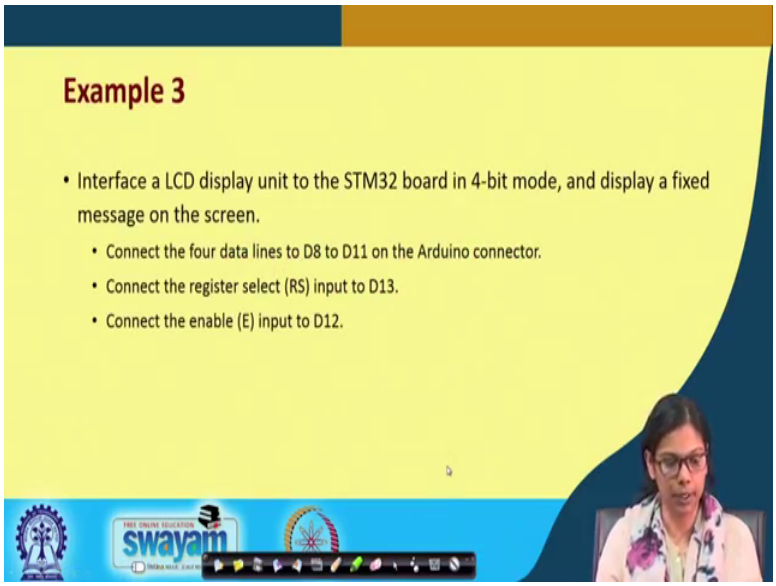

So, what I will be doing in this example, I will interface an LCD unit to the STM 32 board in a 4 bit mode, you already know what is a 4 bit mode and display a fixed message on the screen, on the screen of the LCD. We connect the 4 lines, that is D8 to D11 on the Arduino connector and we connect this register select to input pin D13 and we connect this enable input to D12, these are the connections that are required for STM 32 ok. This is how the connection goes.

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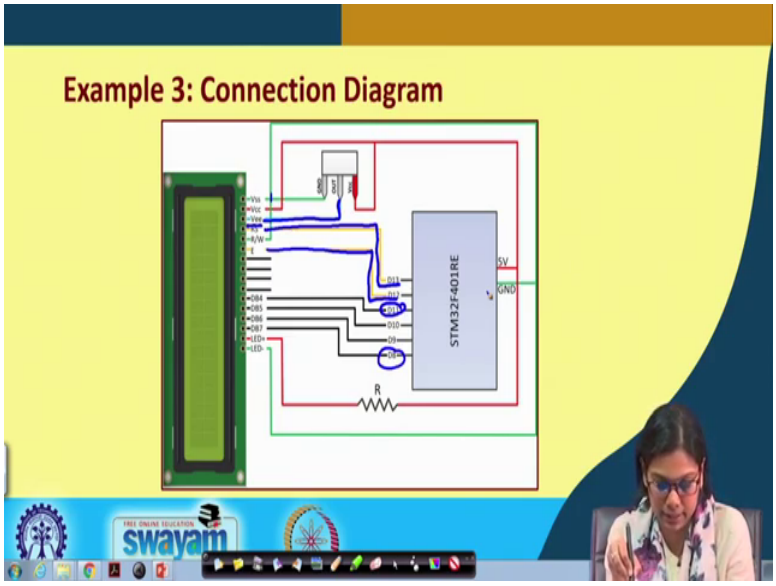

If you see the LCD, it has got these pins. So, the pins are this is V ss V cc V ee R s read write enable and then for the 4 pin board, we do not do anything with the least significant bit, we concentrating on DB 4 to DB 7 and this is for the contrast LED and this backlight sorry, LED and one is LED minus ok. So, how do we do the connection? The connection goes like this, this is connected V ss is connected with this ground this V cc is connected with this 5 volt.

Then we have this, V ee which is the contrast, this is connected to a potentiometer, you see the input to this is connected to the out of this potentiometer and one end of the potentiometer is connected to ground and another end of the potentiometer is connected to V cc. This is how we have made the connection ok, this is for the contrast light of this particular LCD then is the register select which is connected to D13.

Read write is permanently connected to ground, because we are only writing here enable is connected to D to DB4 to DB7 is connected to D11 to D8 and finally, this LED is connected through a resistance to 5 volt and this the next one is connected to ground, this goes with the connection with STM ok.

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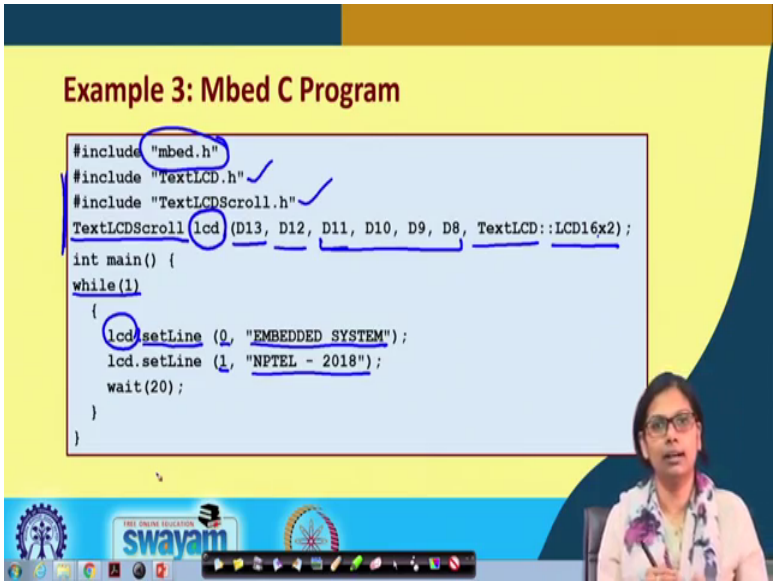

Now, let us see the Mbed program here instead of only including Mbed dot c, we also need to include few other header files. The 2 header files that are required to be included for LCD interfacing is TextLCD dot h and TextLCDScroll dot h and we have to use a function TextLCDScroll. And we can use, we can create an object with the name LCD

and we connect the following pins D13, 12, 11. These are for the data bit line and what kind of LCD we are using? LCD 16 cross 2 the LCD that we will be interfacing it is a 16 the type of this LCD ok. So, this is necessary for LCD interfacing. So, for any other things when you interface this LCD, you need to follow up these steps.

Next is the main program in the wild one, what we are doing LCD is the object that we have created, we are putting, we are using the function set line in the 0th line. We are displaying embedded system and in the next line, we are displaying NPTEL 2018 then we are waiting for let us say 20, some delay we are waiting for some delay and again this whole thing repeats ok. So, this is what we have also done, when we show you interfacing in the next lecture, you will see that it is getting displaying the same thing, but for that you need to do that circuit diagram connection and the following code needs to be executed.

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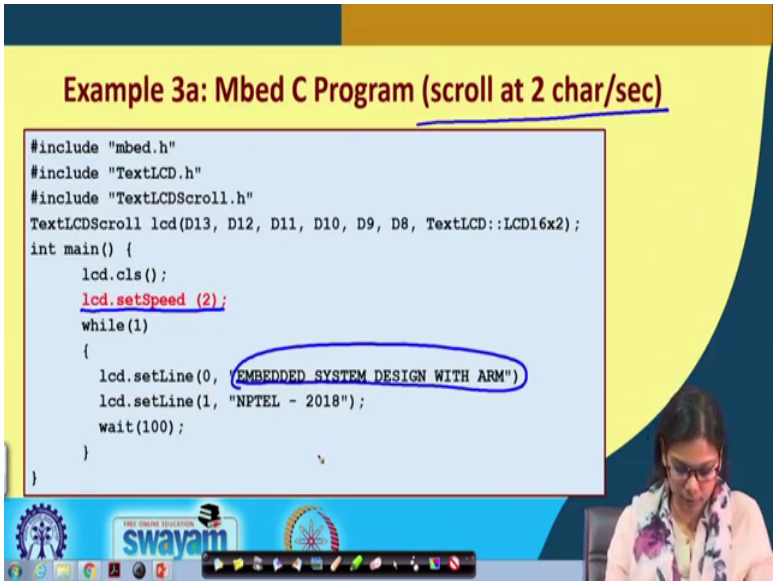

This is the next program, which is fairly similar, but the only difference being here is that the scrolling speed we are specifying, where we are specifying 2 characters will be displayed per second. Till this part, it is all the same here, we have include lcd dot set speed, which is 2, meaning 2 character will be displayed per second and this code is the same EMBEDDED SYSTEM DESIGN WITH ARM NPTEL 2018 ok.

So, this is what it is getting displayed here and one important thing is that, it is 16 character the LCD that we have. So, if the text is less than 16 character or equal to 16

character, it will be displayed, but if it is more than that then what happens, this particular text will be scrolling. It will scroll down ok, with the speed of this which is specified here lcd dot set speed.

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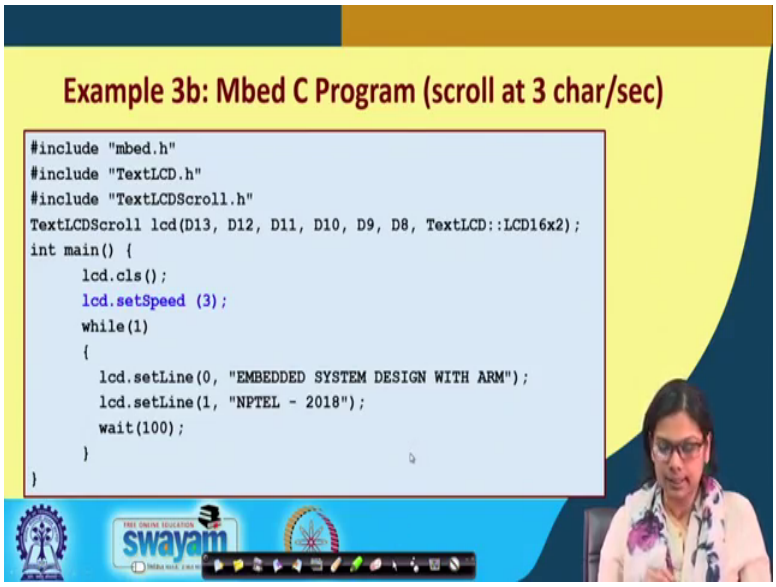

This is another program similar program, just that we have made the speed of 3 characters per second. So, it is another program, you will see that when, we put this code into the board, it will start moving little fast ok.

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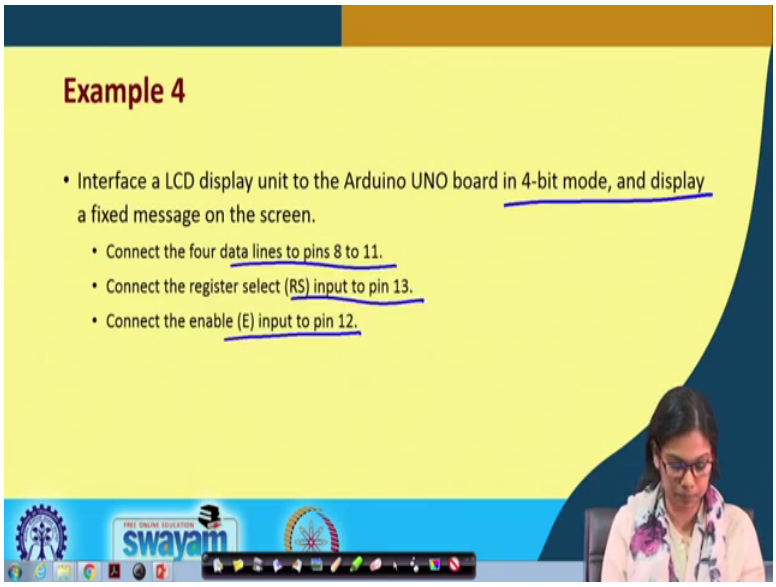

Next I will be showing, how do we interface the same LCD with Arduino UNO board in a 4 bit mode and display a fixed message on the screen. So, here we are not playing around with too many things. So, here we will be just displaying a particular text in the LCD using this Arduino. And, how the connection goes it goes like this the 4 data lines will be connected from pin 8 to 11 the register select will be connected to pin 13 and the enable pin will be connected to pin 12.

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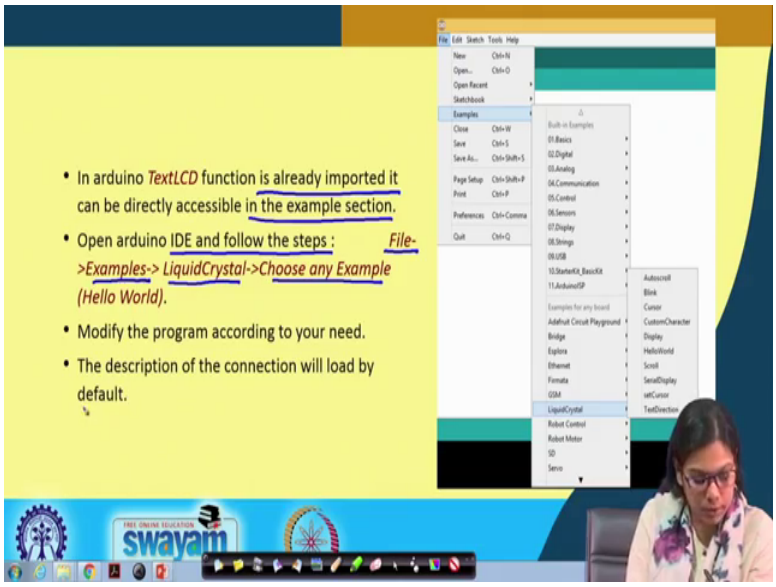

Similarly, as you have already seen that for the previous code for STM, we were using some header files. We were including some header files in the same way for Arduino you have to do the following in order, we know this text LCD function is already imported, it can be directly accessible in the example section ok. In this example section, you can directly use it open the Arduino IDE and follow those steps, you go to file then to examples then you will see liquid crystal choose any example.

Let us say, hello world example and then use that modify the program according to your need like I will display NPTEL 2018 embedded system design with arm. So, this will be displayed here the description of the connection, now will load by default this is how it will be displayed.

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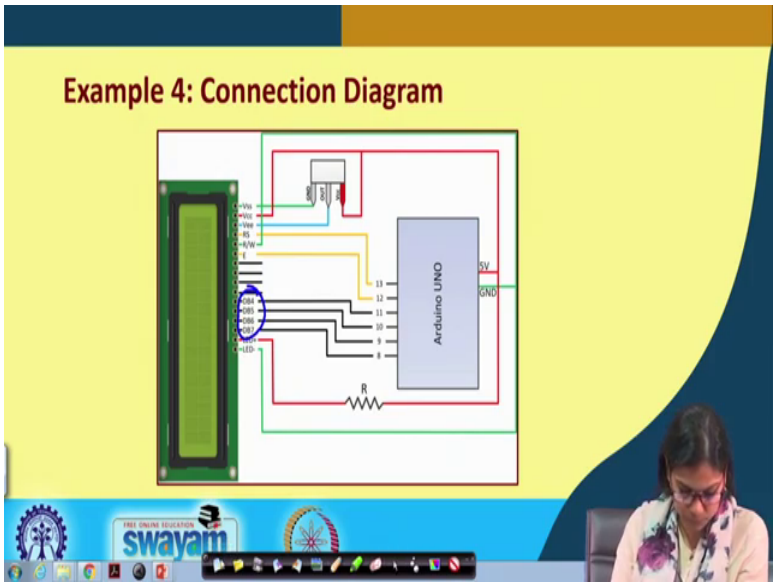

This is the connection diagram, which is a quite similar same V ss V cc V ee will be connected accordingly, this is the potentiometer through which, it will be connected. This is the register select read write directly connected to ground. These 4 pins will be connected to D8 to D13 and this LED plus and LED minus will be connected to ground and V cc through a resistance. So, this is all about the circuit diagram.

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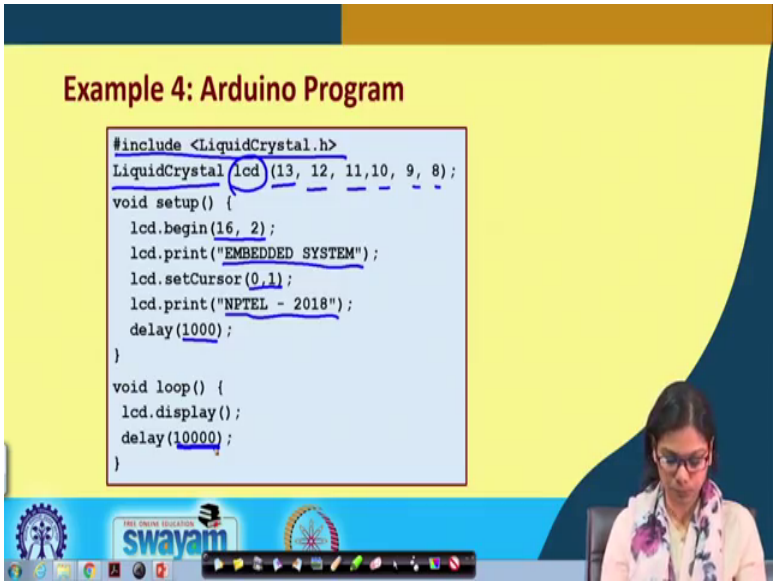

So, this is the code. So, here also you need to include this particular header file that is include LiquidCrystal dot h. Same way LiquidCrystal, you make an object lcd and you

just specify 13, 12, 11 and it will take accordingly. And in the setup phase, you basically we do the following lcd begin, now we specify this 16 cross 2 lcd; lcd print we have given EMBEDDED SYSTEM, lcd Cursor 0 and 1. We have given and lcd print the next, the cursor will now move to this position and it will print NPTEL 2018. And, we give a delay of 1 second and the same thing goes off and this is the loop phase, where we are calling this lcd dot display with the delay of certain unit.

So, we have come to the end of this lecture. So, in this lecture specifically, I have discussed about 2 output device: one is 7 segment, another is LCD. And, I have also shown you the circuit diagram both using Arduino and using STM and how you can display any text using these 2 devices. We will move on and we will be showing the interfacing experiment; now with this in the next lecture.

Thank you.