Embedded System Design with ARM
Prof. Kamalika Datta
Department of Computer Science and Engineering
National Institute of Technology, Meghalaya

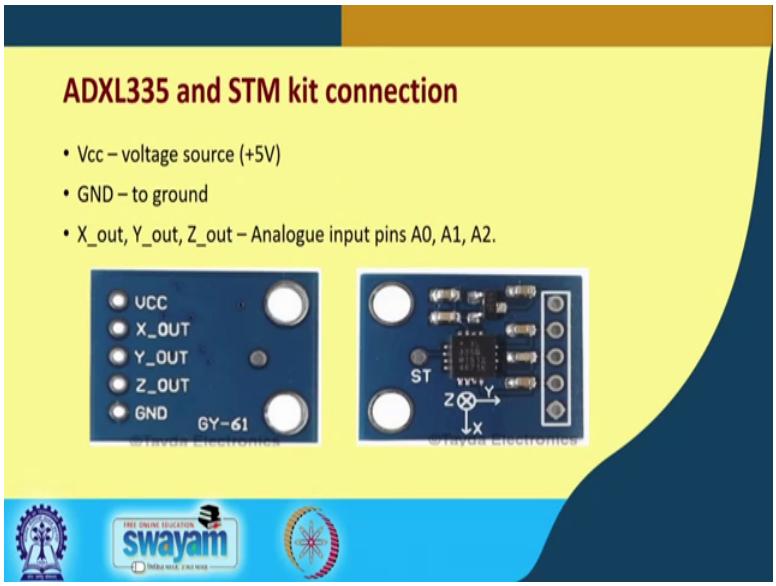
Lecture – 39
Experiment Using Accelerometer

Welcome to lecture-39. In this experiment, I will be showing how we can interface accelerometer with STM board, and what value we will get for the different axis like x, y and z axis in the cool term. We already know how we have to use cool term along with STM board. For Arduino, it is straightforward it can be printed in the serial monitor, but in this case so for STM board we have to install some hyper terminal. So, here I will be using cool term for the same.

(Refer Slide Time: 00:59)

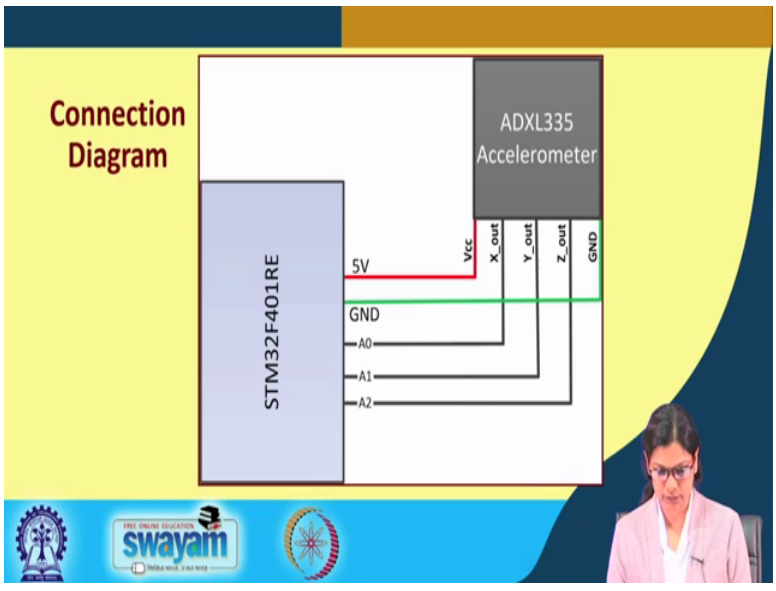
So firstly, I will show you the experiment with accelerometer, and then I will do the demonstration.

(Refer Slide Time: 00:07)



So, this is the ADXL 335 accelerometer, and I will be doing the connection with STM kit. So, the voltage source V CC will be connected to plus 5 volt. The ground will be connected to the ground pin of the STM board. And the X, Y and Z OUT analog pin output will be connected to the analog input pins A0, A1 and A2.

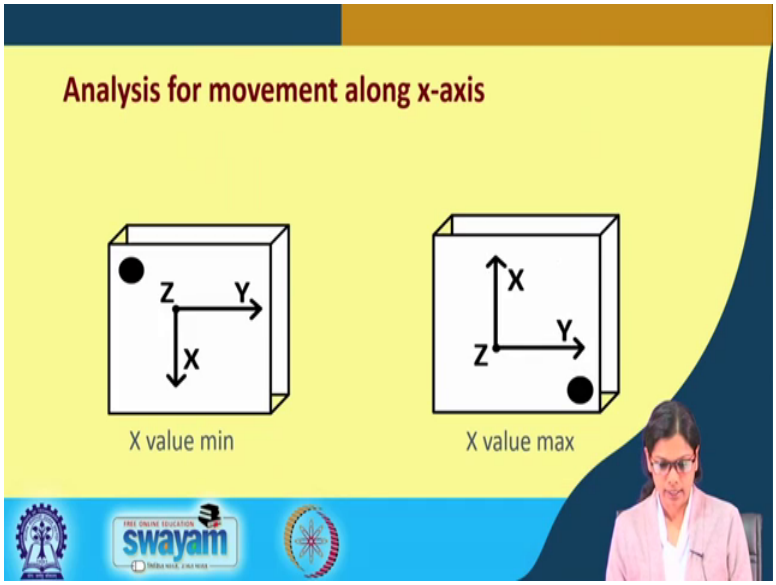
(Refer Slide Time: 01:46)



So, this is how the connection goes, this is the connection diagram. We can see this is the accelerometer. V CC is connected to 5 volt; ground is connected to the ground of STM;

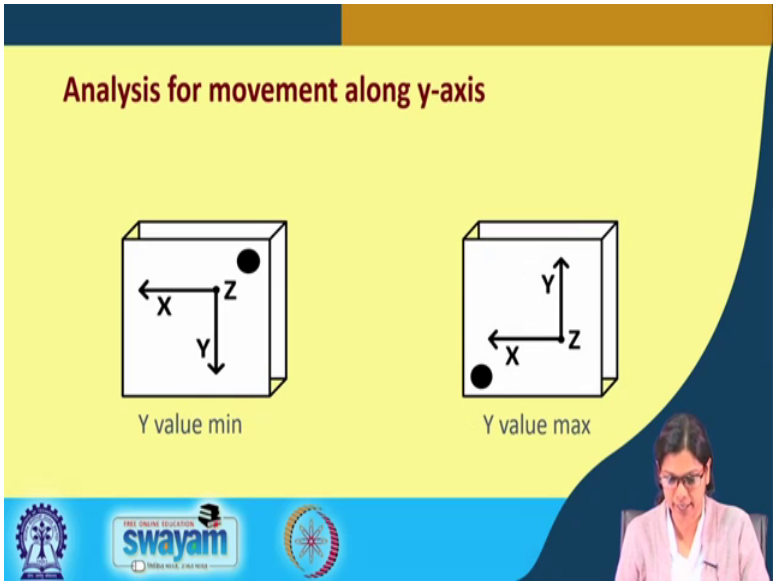
and X, Y and Z OUT are connected with A0, A1 and A2 ok. So, this is a straight forward connection that we will make.

(Refer Slide Time: 02:09)



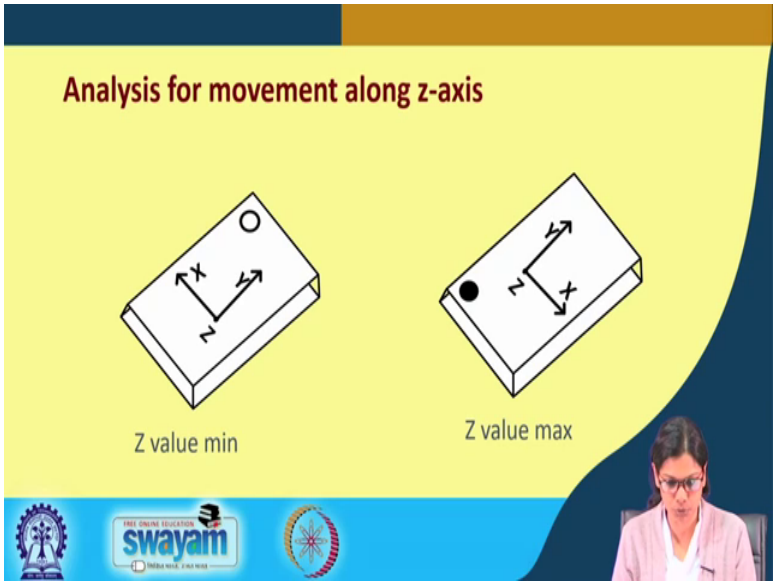
And then let us understand this analysis for the movement along x axis. When you hold the accelerometer, you will find out that that accelerometer is having certain axes, one is the long X, another is Y and this one is Z. When you hold the accelerometer towards this X along this X, then you will see the highest value that you receive for this X. Similarly if you hold, and if you hold it like this, value of X should be minimum.

(Refer Slide Time: 02:54)



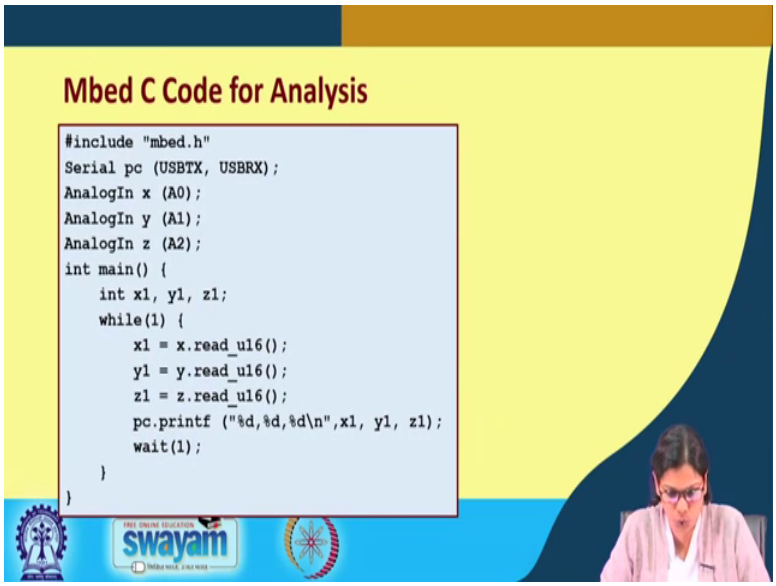
Similarly, for Y if you see, if you hold it this way, the Y value will be maximum; and if you hold it in this way, the Y value will be minimum. Depending on this you will be able to actually understand how you are holding the device whether the device is straight or it is tilted or it is vertically tilted to the left or it is vertically tilted to the right. So, different orientation of a device could be figured out from this value.

(Refer Slide Time: 03:27)



Similarly, if you hold the accelerometer in this direction, then the Z value will be minimum here, and the Z value will be maximum here ok. So, we will try out this with the STM kit. Prior to that I will discuss the code, once I discuss the entire code then I will be going and showing you the demonstration.

(Refer Slide Time: 03:56)



So, let us understand the Mbed C code. So, this says that we have to include the mbed library mbed dot each. First thing we have to make the serial communication with USBTX and USBRX with the communication named as pc. We defined three analogue input signals here one is AnalogIn x, the name we are giving it as x, which will be connected to port pin number A0 of the STM board. Similarly, if you see this next one, this is the analog input pin y which will be connected to A1 pin of STM, and the analog pin analog input z the name z will be associated with A2.

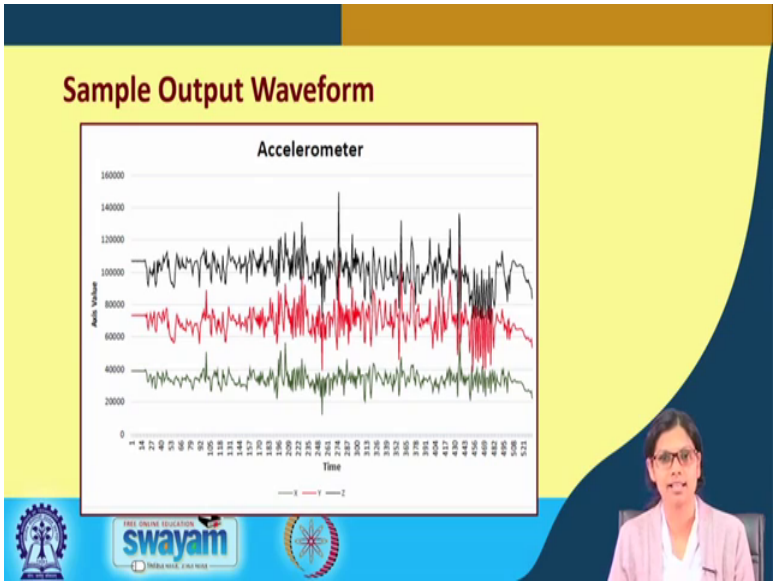
So, X OUT, Y OUT and Z OUT will be connected to the Arduino analog, the Arduino compatible of course, the STM pins which is A0, A1 and A2, then goes the main function. In the main function we define three variables that is x 1, y 1 and z 1, where we are reading the analog value using the function x dot read underscore u16, y 1 will be y dot read underscore u 16, and z 1 will be z dot read underscore u16. And what we are doing the serial communication with the name pc that we have already made will be used to print the values of this x, y and z coordinate, which is stored in variable x 1, y 1 and z 1.

So, this is how it goes. And this is going in an while loop, but after 1 second it will get printed ok. It will after it gets printed it will wait for 1 second, and again it will do the same process. So, if you see the code, the code is fairly simple where we are just connecting the analog pins A0, A1 and A2 with x, y and z output of the accelerometer.

And then we are simply printing it to the hyper terminal. Here we will be using cool term as I said.

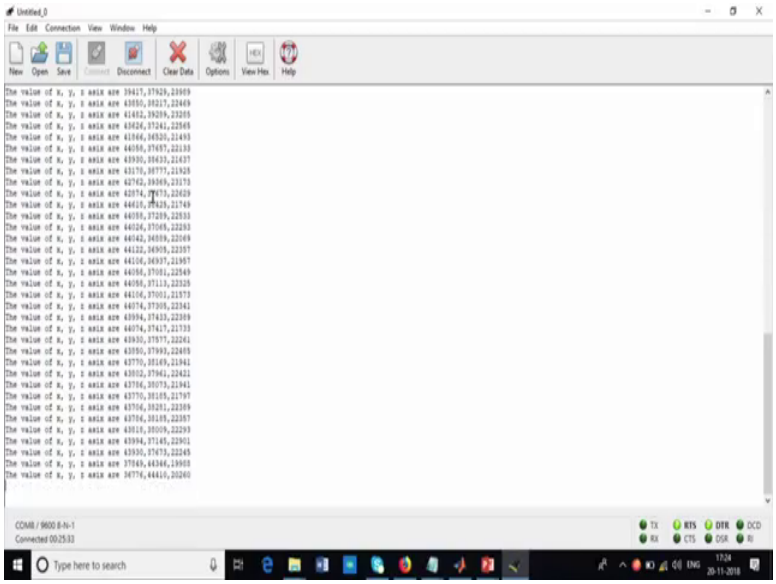
What you can do basically if you wanted to see, the how the x, y, z coordinate value changes, you can also use some kind of MATLAB code to display it which we are not showing it here. But if you are interested, you we can share those codes with you, you can try out at your end by plotting this x, y, and z coordinates ok. Or, you can do another thing, you can read this value store it in some online database as we have shown you earlier using the SMS control you can use the GPRS facility to upload that. And whatever value is stored in the database, you can actually analyze it based on that you can plot that as well. So, there are varieties of ways you can do it.

(Refer Slide Time: 07:38)



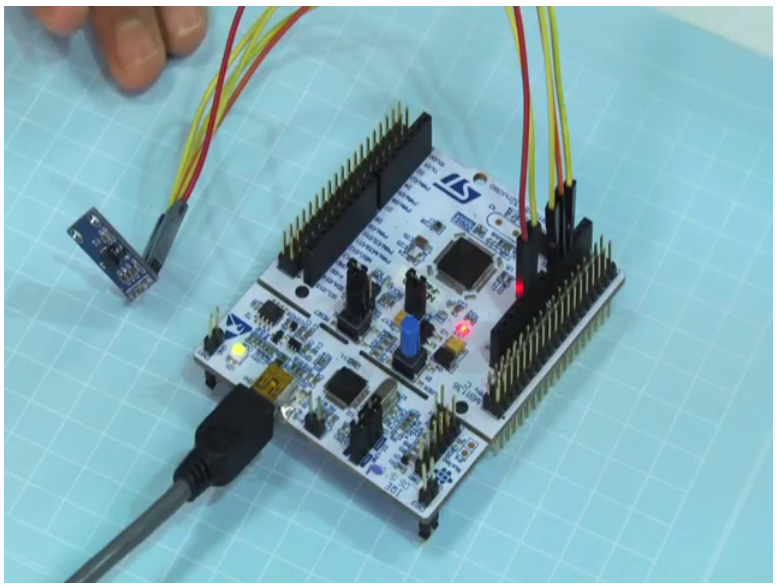
So finally, the plot looks somewhat like this. This is the sample out output waveform from the accelerometer. So, this is the x-axis, y-axis and z-axis value this is how it is changing ok. So, there are certain spikes as well we can see here and here there are certain spikes. So, this is how this particular plot looks like when we use the accelerometer, and we accelerate we move it up and down or in any position. So, now I will be showing you the demonstration of this using cool term.

(Refer Slide Time: 08:27)



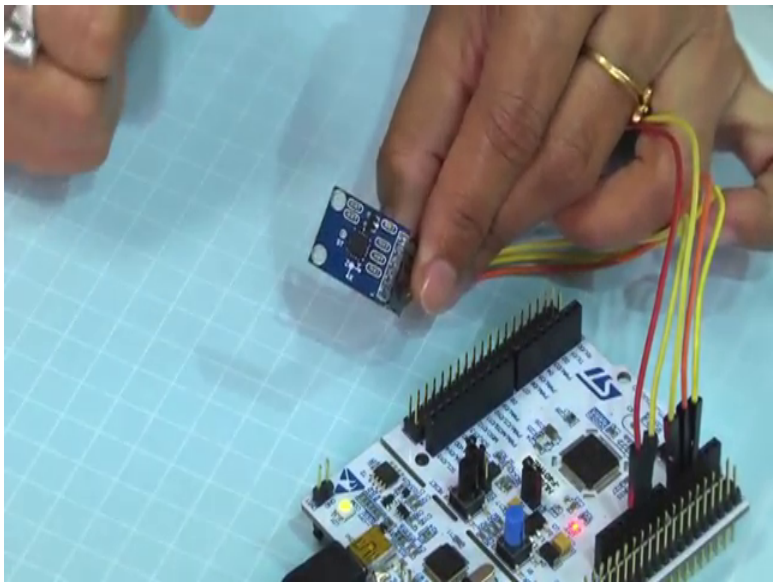
So, first of all you have to do the needful. You have to use this cool term ok; where I am clearing the data. So, some data it is coming. So, first we will see the connection here ok.

(Refer Slide Time: 08:42)



Now, see how we connected here. This is basically this one is the V CC, this is the V CC which is connected to 5 volt. This is x axis which is connected to you can see A0. This is y axis this one which is connected to A1. And this one is z which is connected to A2. And finally, this one is connected to the ground pin ok. So, the connection is fairly straightforward, this is all is required here for the connection.

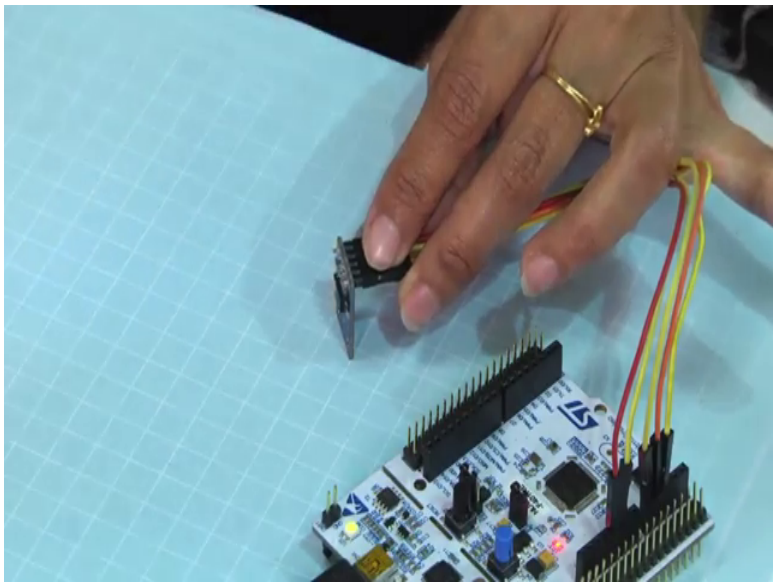
(Refer Slide Time: 09:40)



Now, if you, if you see this accelerometer properly ok, if you see this accelerometer properly, you can see there is x, x axis here you see this there is x axis here. The same way I have shown you the diagram this one is the x axis, here is the y axis ok, and this is the z 1 ok. So now, you will see that whenever you hold this accelerometer with the arrow towards this x axis in this fashion, then the x coordinate value will be the highest.

So, let us say I have hold the accelerometer in this fashion and will come and see the value of x in the hyper terminal. So now, see so these we are printing the x, y and z axis values, you can see the x axis value is 44058. The y axis is 36873 and of course, it varies ok, it is not the same although I have hold it very tightly, but still there are some variation there is a noise etcetera, etcetera. So, there is the variation. So, this is the x axis value.

(Refer Slide Time: 11:16)



Now, I will make sure that now I will make sure that the y axis value will be maximum. So, I have put up the accelerometer with y axis at the top. So, now, you can see in the hyper terminal what value you are getting. So, just see what value we are getting, we are getting the x axis value as 36728. The y axis value is 44426, and the z axis as 18628. So, what is the idea of showing you these values. So, the idea of showing you this value is that suppose, you have this particular device put in, in some, some other device.

Let us say you have a small piece of some box in place where you wanted to see that the orientation of that particular thing should always be like the head of that particular thing should be at the top. So, you can always make sure that the x axis value should be high such that you have put up this accelerometer in that application in such a way that x axis is like this. So, if it is like this, the x axis value you will receive the highest one. And if it is not the highest, then the other two values are highest, then you have to make sure that your device is not properly placed ok. So, some kind of alert maybe given that the device is not properly placed. So, these are the values which are coming.

From this experiment, what we have understood is that how we can interface the accelerometer using STM kit. And like if you want to find out the orientation of a device how we can find it out using this. And if we want a particular device to be placed in a particular way, we can ensure that using this. So, if somebody changes it, an alert can be sent out ok. And in every mobile device this accelerometer, we have this accelerometer

in place. If you must have used some kind of apps like health monitoring app right, what it shows, it shows you that how many how many steps you have walked in a day let us say ok.

So, these are measured using this device. So, inside our mobile phone, we have an accelerometer or a gyroscope, so that gives us the acceleration movement that we make in a day. Of course, there are some issues with these devices as well, because if you are just having a jerk then also, it will take into consideration that you are walking ok. So, those things we need to look upon when we build an application, but generally this is the application of accelerometer, which is in various health monitoring apps the smart watches that we use. So, all these in all these devices this accelerometer is there.

Thank you.