Embedded System Design with ARM
Prof. Indranil Sengupta
Department of Computer Science and Engineering
Indian Institute of Technology, Kharagpur

Lecture – 33
Experiments with Multiple Sensors and Relay

If we recall in the last two lectures we had seen that how we can interface devices like relays DC motors etcetera to the microcontroller and we can do some kind of a control and also we can sense the values and so on. Now in this experiment that we shall be showing you in this lecture, we shall be trying to demonstrate that not only one device or one sensor the microcontroller is powerful enough to control multiple devices at the same time. So, this particular lecture is titled some experiment with multiple sensors and release.

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Now, here we shall basically be looking at how to interface multiple such devices multiple sensors and multiple output devices and we shall be demonstrate this kind of an interfacing to you.

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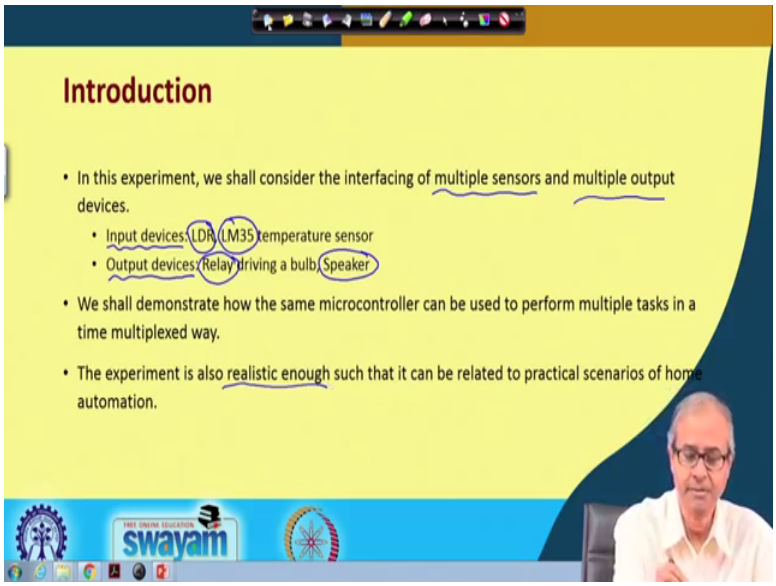

Let us talk about the experiment first now in this experiment as it said we shall be interfacing multiple sensors and multiple output devices; specifically the input devices that we shall be looking at are LDR for sensing ambient light and a temperature sensor for sensing the temperature of the environment.

Now, the output devices that we shall be interfacing are one relay circuit that will again be driving that bulb as we have seen in the earlier lecture and a speaker. Now the kind of an environment that we are trying to show you is suppose first one is the one that we have already shown earlier depending on the ambient light you can automatically switch on a switch off a bulb through a relay.

And secondly, there can be something like a fire alarm system, there will be a system which will be sensing the temperature and whenever the temperature crosses a certain threshold preset threshold there when alarm that will be sounded and for that alarm we have interfaced a speaker circuit ok.

So, we shall be showing you, how you can write a code for that and as I have mentioned the example is realistic enough. So, that you can have an automated light on or off system and an automated security system where you are censoring sensing some kind of fire a fire occurrence by looking at the temperature level.

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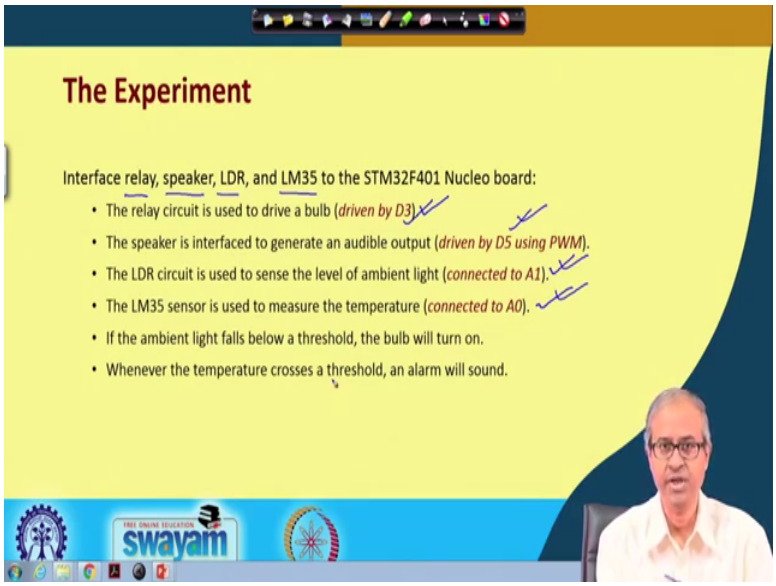

So, specifically in this experiment as it said will be interfacing a relay per speaker and LDR and LM35 and these specific ports that will be using the relay will be driven by digital port line D3. This speaker will be interfaced from port line D5 the LDR circuit the output of it will be connected to the analog input A 1 and the LM35 sensor will be connected to analog input a 0.

Now, if the ambient light input falls below a threshold the bulb will turn on and as I said whenever the temperature cross the threshold the alarm will sound. Of course, in this experiment will not be able to show you the variation and temperature, but at least the circuits and the way it works you can understand that.

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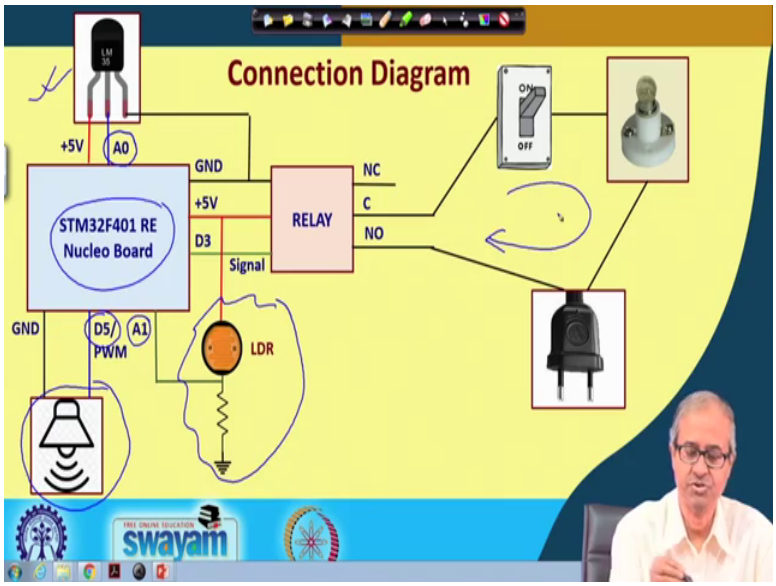

Let us look at the connection diagram first this is your STM board and this is relay circuit is the same as we had shown earlier this is the same circuit and on one side we have on we just LDR circuit which will be sensing the ambient light there will a resistance divider the output is connected to the analog port line A 1. On the other side you have the LM 35 temperature sensor which will be generating the output on analogue input line a 0 and for alarm you have a speaker which is connected to D5 which is a PWM control output port.

So, whenever the temperature crosses a threshold this speaker will be sounded and whenever the light falls below a level this relay will be activated. So, that the light turns on.

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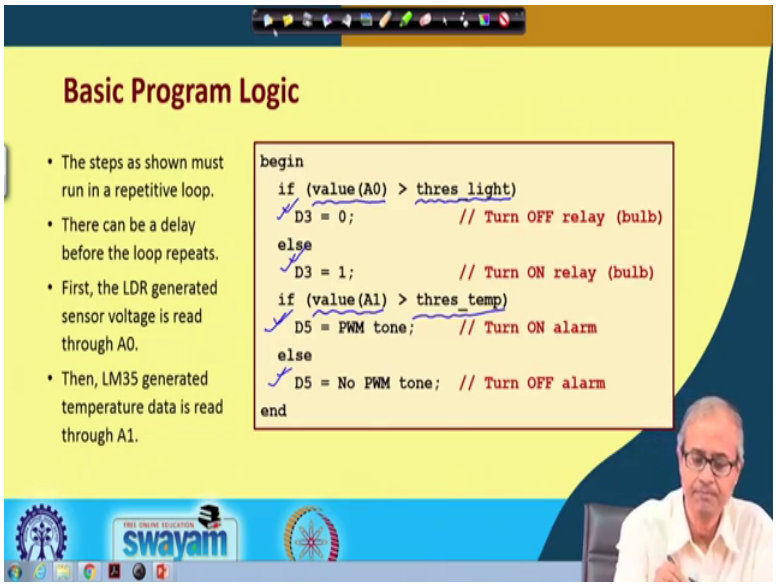

Let us look at the program logic first then we shall be showing you the code. The steps as shown here will be running in a repetitive loop what we will be doing I mean essentially this is not the correct c code just the steps I am trying to show. First we will have to check the value on the analog input line a 0, if it exceeds the threshold level for the light that we are trying to sense you turn off the relay; that means, you have sufficient light otherwise turn on the relay; that means, the bulb will glow.

After that you check similar thing for the temperature if the value on port line A 1 analog port line A 1 is exceeding some threshold level, then you play a tone on the speaker which indicates some alarm, but if it is not there will be no PWM tone; that means, you do not play a tone now let us look at the program.

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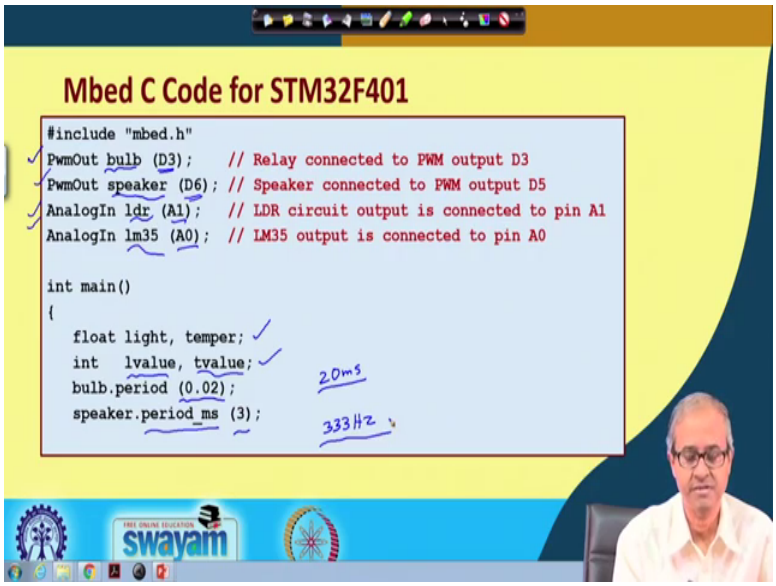

The program will start like this. So, you are defining a PW outline on D3 which you call as bulb then another PWM out on D6 which you call speaker and there were two analog inputs one on A 1 A 0 corresponding to LDR and lm thirty five.

So, these are the names we have given bulb speaker LDR and LM35. And some variables you have defined light, temperature for calculating the analog inputs and lvalue and tvalue some temporary we have temperature value we have used two variables integer. And for activating the bulb we have assumed that, we have using 50 hertz PWM 0.02 which means, 20 milliseconds right, 20 milliseconds means 50 years 50 times per second. And for speaker we have set a period of 3 milliseconds we have called the function period ms where you can specify the time in milliseconds. 3 millisecond means approximately 333 hertz of frequency will be played on the speaker.

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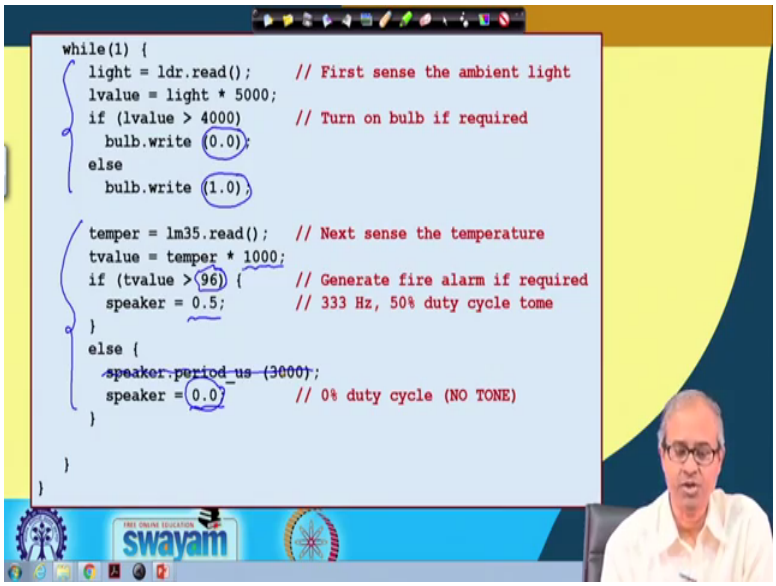

Then let us come to the rest of the main function. So, in a repetitive while loop we are checking the light here we are checking the temperature here. In the light we are using the analog input function LDR read then you are multiplying it by a scale factor just like in the program that we showed earlier. If it exceeds some threshold value we turn off the light because there is sufficient light if not you turn on the light.

So, I did the duty cycle is 0.0 or duty cycle is 1.0 while instead of right you can also write bulb equal to 0.0 bulb equal to 1.0 they will mean the same thing here I have shown that way. Similarly for the temperature you are reading the temperature, you are again multiplying it by some scale factor here. I am using 1000 and some threshold which again can be found through experimentation depends on the temperature where you want to start the alarm. So, you said that accordingly and if it is show you play a continuous note on the speaker 50 percent duty cycle; that means, there will be a continuous tone of 333 hertz with 50 percent duty cycle will played, but otherwise if not then you set the duty cycle to 0.

Now, this line is actually not needed this line you can also omit this is not really required because, once you set the duty cycle to 0 the period does not matter ok. So, this line also you can omit this is how the program works; let us look at the demonstration now. So, this is the code.

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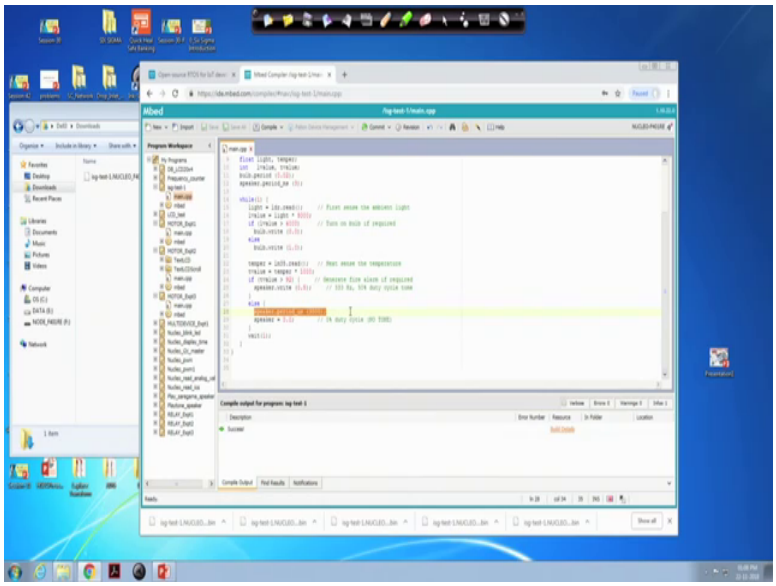

This line you can omit we do not need this. So, let us compile this code. So, we compile it we save it copy and paste.

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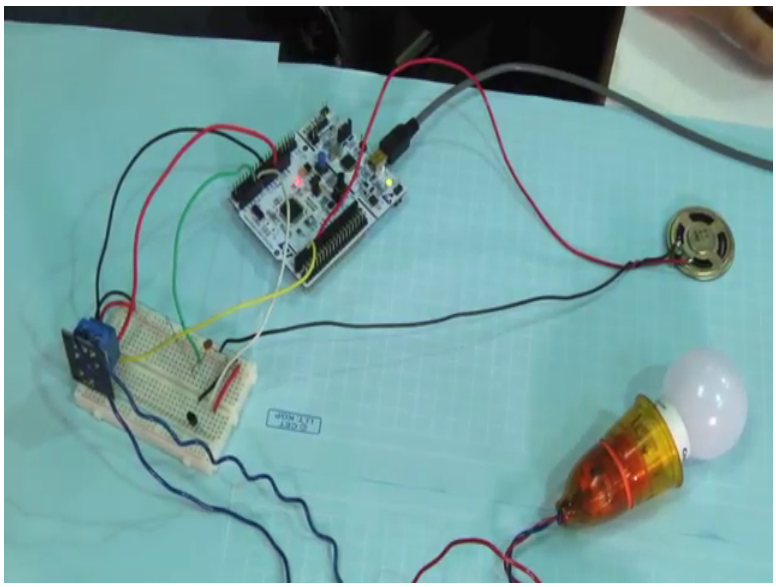

Now, let us come to this circuit now see we have used that same light interfacing circuitry as was shown earlier a relay a bulb with a switch connected to mains and we have used the same LDR circuit you see if LDR is interrupted, the light is glowing if LDR is interrupted the light will glow. You see if it is released again light will and here you have this LM35 setting here; if LM35 temperature exceeds the threshold, but as I

told you here I cannot show you the exact temperature rise because we do not have any heater or anything here in this setup. But if it is the voltage is high enough then there will be an alarm tone here yeah you see the temperature has just increased beyond a level and this alarm has started to rise.

So, I am just pressing with my finger so, that the temperature increases that little bit. So, if you are the heater you can show it in a very clear way yeah you see there is an alarm sounding yeah. So, see this is alarm is sounding because it is just crossing threshold, but if we can heat it a little further then there will be a very clear sound that will be coming and the LDR you see LDR if I press darkness light is glowing if I release light is switched off again if you press the LDR light is glowing again releasing light is off. So, in this experiment what we have seen is that we can have multiple devices.

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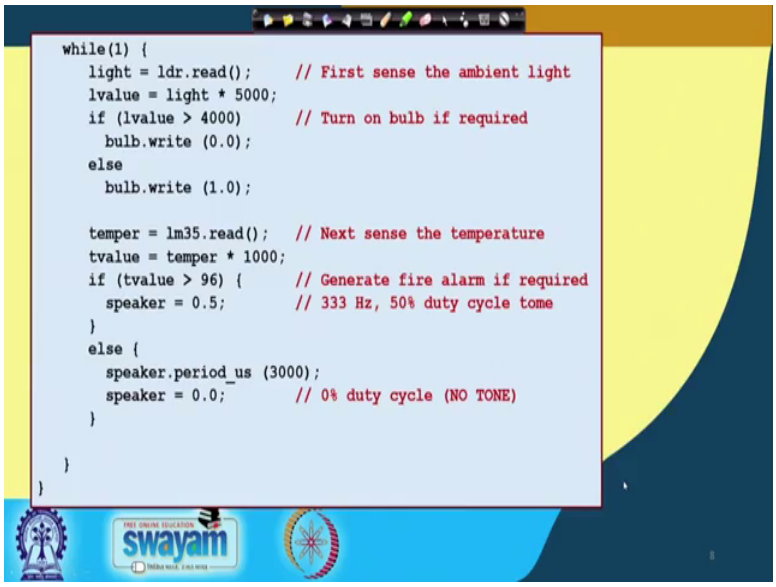

See means when you talk about home automation in your home there can be. So, many kind of devices connected there can be not 1 2 nowadays there can be 10s or even 100s of devices we talk about. Now this micro controllers are powerful enough says that a single such device will be able to control the entire thing. The only thing is that you have to write your program in such a way some of the devices will be sending the inputs and interrupt driven mode some of the devices you can just read them one by one just in this experiment as I have shown you read the light, read the temperature in a loop one by one.

So, it depends on the type of devices the way they are sending you the inputs ok. So, we shall be seeing more demonstrations on these in your later lectures, where you will also be looking at some ways of communication how the device can communicate with the outside world we have. So, far only talked about interfacing with sensors and output devices. So, these we shall be seeing in our next lectures.

Thank you.