

Sensors and Actuators
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Lecture – 34
Demonstration on peristaltic pump in cleanroom

Hi, this will be the lab class number 13 and like you can see there are few more lab class left and we have given a lot of weightage on the laboratory component because I am sure that you have learned lot of theoretical components even in your courses right. If you take a VLSI course will be taught a lot of things on lithography and etching and silicon dioxide growing, but how exactly it looks like and how can you use it and that is why I thought of you know keeping more weightage on the laboratory component. So, this will be lab class number 13 and here we will be give you a kind of a hands on training of course, you are not here.

So, it is not really a hands on, but we will be demonstrating how to use the peristaltic pump and the component within the peristaltic pump. So, initially if you remember the peristaltic pump that was just an kind of the teaching us and showed to you how the peristaltic pump looks like, here we will be showing how can you operate the peristaltic pump right. So, that is more focus on the operation of the peristaltic pump and then we will follow with the lab classes so, that you have a better idea of where to use this kind of equipment. Till then you take care have fun have fun the lab classes I am hoping that you are enjoying lab classes and you are learning from the lab classes right.

Till then you take care I will see you in the lab class next lab class I am really sorry you see. So, twisting of tongue right and that is also a sensor, e nose is something that right now people are working on which uses array of gas sensor, but same thing tongue e tongue is another research area where people are understanding how can you give the robot a sense of human taste. So, the human taste means not really testing a human my point is how can we taste different food, how our tongue works right like a how our nose work how our tongue works right. So, array of chemical sensors or biosensors can be placed inside of to replicate the tongue, there is another domain of research like e nose and same thing other domain is for the optical sensors, another domain is to understand the micro needles in the brain, another domain is to understand the bio reservable sensors.

Where you just load or in insert the sensor below the subcutaneous region and it is like once you insert it, you do not have to worry about re operating the patient because the sensor will dissolve within the body. So, a lot of interesting research domain you can think about working one once you understand the this lab components and the particular course right till then you take care I will see you next class bye.

Hello everyone, welcome to the course on sensors and actuators. Today in this module we will see more about peristaltic pump. Like I mentioned when we were talking about pumping action why does it become important when we are studying about sensors. So, like we mentioned we will be studying how to make bio MEMS, MEMS based chip which would mimic the human environment, the biology and physiology of the human body like the heart or the lung can be mimicked into a chip like I mentioned before the bio chip. So, how do we drive fluids through these micro channels? Like I mentioned the chip are there they have channel dimensions which are a few microns in length and width.

So, how do you how do we how do how does one drive fluids through these micro channels? In order to have this mechanism we have something called as peristaltic pump and they are of 2 type that is the host pump and the tube pump. So, when we are talking about peristaltic pumps. So, they have tubes silicone tubing which are supported on rollers. So, there is compression and decompression this action creates a pulsating movement.

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Just to give you an example this is one such peristaltic pump in my hand. So, this here is the peristaltic pump here this is nothing, but a DC motor if you see the white the cream tubings here these are the silicone tubings. This could be this is this could be the inlet and the outlet depends on how you have connected it and how and you can as well program these devices. So, let us see what goes into the peristaltic pump I will remove the top casing from this.

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So, we have two paths here this here is the motor and what the motor holds on top is your device something like this. Now let us see what is inside this.

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This these are again called as silicone tubings through which the fluid can be pumped.

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So, when we remove the casing from bottom these are the tubings.

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And here what we see is nothing, but these are the rollers 1, 2 and 3 rollers. So, what happens is as the motor drives it pushes the 3 rollers at the set R P M. The RPM in which your motor is driving it drives the 3 rollers here and the surface here the tubing which is here in between the roller and the outer casing if you observe is compressed. So, what happens is as it moves

through the stage 2, this portion release gets released and the next one gets compressed. So, this cycle as it proceeds through throughout the rotation period, there is a pulsating action created and this pulsating movement can cause the fluid to flow in a unidirectional flow that is if your inlet is this and your motor direction is clockwise and then you would have the entire fluid flow in the clockwise direction.

So, this was a simple casing how a peristaltic pump can look like otherwise the again depending on your requirement the volume of fluid that will be flow through again should be considered. If you see this is relatively 3 m m inner diameter silicon tube. So, this is a 3 m m inner diameter silicon tube. So, they are relatively it can carry more volume of fluid. However, when we are talking about the peristaltic pump which will be used for driving fluids through micro channels, the silicon tube has smaller diameters let us get a hands on the peristaltic pump which is used to drive fluids through micro channels.

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Here as you can see this is a peristaltic pump a tabletop pump with 4 channels 1, 2, 3 and 4 when we have this device. So, it has one inlet and one outlet and when we do a comparative study the dimensions of this silicon tubing is much larger when compared to silicon tubing which is here. So, this has 1, 2, 3 and 4 channels and you can program it to have a different r p m depending on the requirement.

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So, the flow rate this could this can be the inlet and the other end can be programmed to be outlet. So, if you have to pump fluid at a certain flow rate, then in a clockwise direction. So, you can have this pump programmed to rotate in a clockwise direction the rotor which is inside. So, these are; so, this here is the tabletop peristaltic pump; however, when we are talking about micro fluidic devices where you need to drive fluids through micro channels, syringe pump is also used. So, there are 2 types; one is the syringe pump and the other one is a parasitic pump, focusing more on the peristaltic pump here.

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Here there is like I mentioned these are called as the cassette and when we remove this cassette this is the tubing bed 1, 2, 3 here like I mentioned in the previous case there were 3 rollers; however, here there are 6. So, the number of rollers can vary from 2, to 16 depending on the number of pulses which can be generated as your fluid flows that is a pulsating flow of the fluid.

So, here you can see the tube which this is called as the tube bed and here as we compress this portion the tube gets compressed between the roller and the surface here and then a pulse pulsation is being created. And we have 4 such tubes running on a similar fashion. Now that we have seen how these 4 cassettes are having rollers which rotate depending on the RPM set by the rotor which is inside and then there is a tube bed on which the silicon tubings are placed. Now let us see the features of the device.

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Here the display has a home screen. So, now, the display here shows one which is nothing but channel 1. You can choose to program each of these channel independently this is the 2nd cassette, 3rd and then the 4th. Here in this option you could select the language and this is a calibration setup, here this talks about micro liters per unit of time. So, how much of fluid the volume of fluid needs to be flown for a given instant of time and this here indicates the direction of the fluid flow this is anti clockwise. So, this on the right side behaves as the inlet and you this can be this will now behave as outlet, if channel 1 is programmed like this in the anti clockwise direction. So, we will have 100 micro liter fluid flowing per minute.

For 60 seconds there will be 100 micro liter of fluid transferred from my right hand side that is the tubing from here to the left hand side and going forward let us see what are the other things that can be programmed. Here the tube inner diameter is what is being measured this is 0.13 mm. So, the tubing here is almost 100 micron inner diameter, now you could now that you could see what how small the inner diameter is the volume of fluid that can be carried through this is also very very small.

So, this the inner diameter is of 100 micron, now let us check the other features with the offered in this peristaltic pump. The rate at which the fluid is flowing and time can be adjusted again for each channel and this is talking about status of each that is we have already configured each of these channels for some values for some readings and the home screen talks about that. You can even create a pulse pulsating like I mentioned you could have this entire flow controlled you can play I mean have the fluid flow stopped and then again resume the fluid even that can be programmed depending on the requirements.

This here can be used to set your the fluid flow rate, now that we have seen channel 1 to be configured channel 2 in the anti clockwise direction, 3 again in the anti clockwise 4 in the anti clockwise direction.

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Now let us open one of these cassettes and see how the flow actually happens. Like you can see it is moving in the anti clockwise direction because of the program and it has been set to

run at certain RPM and the volume of fluid is around 0.1 milliliter per minute. Let us set channel 4 to work in clockwise direction.

Now, let us see I mean channel 2 and the flow all the 4 cassettes had anti clockwise direction, but then in channel 2 let us have flow rate in the clockwise direction and it is running at 0.1 milliliter per minute and this can go on up to 300 seconds which is a very long time. Now, **so**, you can see each of these running at different RPM because of the program here 1 and 2 1, 2 2 is rotating in the clockwise direction 3 and 4 in the anti clockwise direction we have programmed 3 to run to we are programmed 2 to run in clockwise direction. Let us have all the cassettes back and then assume I have some fluid in the second channel to which I have programmed.

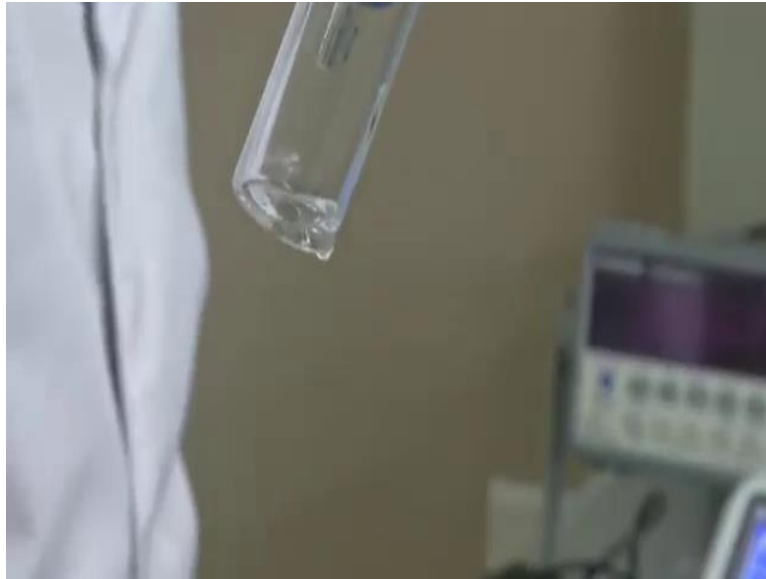
And since the time here is very long I will reduced the flow rate and the time and then you can see fluid flowing from channel 2 in the clockwise direction. Now we are we have programmed channel 2 to work in clockwise direction and I have reduced the time to 10 seconds. So, the volume of fluid is this which will flow from left to right in 10 seconds.

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If you observe this is this here is channel 2. So, this is the droplet here which is getting collected inside this container.

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So, here as you can see we had programmed the channel to flow in the clockwise direction and this is the liquid. Which got collected into the container here you this is nothing like if I smell it this is acetone this is not a simple water. So, here what you can observe is it is not just fluids like water which can be driven into the channels even viscous fluids can also be driven through these micro channel there are experiments where you want to have fluids flow have properties like blood. So, you have different combination and viscosity the property of fluids vary.

So, such fluids can also be flown through these channels. So, now, we had acetone which got pumped from one channel to the from one side to the other side of are peristaltic pump. So, this was a brief about how pumps can be used to flow of fluids in one direction and have you can channel and program the device the in the clockwise anti clockwise or you can alter the r p m at which the motor is running so, that you can control the volumetric flow rate at which the fluid is flown through the micro channels.

Thank you.