### Tools in Scientific Computing Prof. Aditya Bandopadhyay Department of Mechanical Engineering Indian Institute of Technology, Kharagpur

### Lecture - 42 Balloon problem and viscous fingers

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Hello again, welcome to this next lecture where we going to proceed with the image processing part. So, so far we have figured out what the thresholded image looks like. Now, what we are going to do is actually find out the contour on that image; the contour that before, but before that we have to first detect the edge. So, let us do that. So, we are going to say edge = cv2.Canny image threshold.

Whatever we thresholded Canny lower limit Canny upper limit and yeah that is it. Then we will do cv2.imshow("Edges of the image", edge) we will say edges of the image we are going to plot edge. Let us see what we get.

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So, this is what we obtain as the edge of the image it is quite nice to be honest. And so what did we start with? We started with an image which had or a frame which had my hand bunch of other things and thanks to the very first step in which we mixed the modes or mix the signals or mix the channels rather.

We were able to get rid of all those things we smoothened the image actually even if we do not smoothen the image nothing much changes, but it is always a good thing to smooth it ok. For finding out contours and all it is always a good idea to have less information. Then we have 2 contours, one is the two edges one is the outside thing another one is the inside thing.

So, the inside thing it comes up because of that reflection of the light nothing else, but we will see once we detect the contours that it will it will not cause a lot of image a lot of issues. So, now that we found out the edges of the image we are going to pass the edges to find out the contours. Well you could have done it directly with the thresholded image as well, but regardless.

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So, we are going to do contours hierarchy well, you can call them anything you want is equal to cv2.findContours you are going to pass the image from which you want to find then you going to say RETURN EXTERNAL and you are going to CHAIN APPROX NONE. So, the findContours function it requires the image then it requires information about how you want to return the contour. So, RETR EXTERNAL means in that image.

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So, let me run this. So, when it is going to detect these two contours it is going to give you only the parent contour because inside that parent contour there is a child contour as well. So, you are going to remove that contour from the list alright.

So, this is a very important thing you only want the biggest contour or the enclosing contour if you do not do this it is you are going to get this contour as well or you do not want that then you do cv2.CHAIN\_APPROX\_NONE so.

Is the purpose of CHAIN APPROX NONE, if you have for example, a straight line and you do not want to save all the points on the line we can simply save the two points. So, if you do CHAIN APPROX simple you are going to save the end points you are going to interpolate once you start doing something with it, but in in this case we have a complicated surface. So, we do CHAIN APPROX NONE right.

This helps you obtain the various contours not the various contour, but the largest contour. So, now, once we know what the contours are we will do cv2.DRAW on oops cv2.drawContours then we are going to plot the contour on the original image.

So, the original image was this alright. So, drawContours on image we are going to draw the contours we are going because there is only one contour. So, 0 means, so if you do minus 1 you going to plot all the contours 0 is the id of the contour.

In this case you have only one contour. So, contour 0 is the equivalent of this, then you need to specify the color of the contour. So, color will be specified as the tuple like this and we have to give the line thickness of the contour. So, it is going to overlay the contour on the image and show it alright.

So, let me save this and let me see what happens where is the original image? So, we need to show the image again cv2.imshow("image with contour", img) we have to give the name image with contour image alright.

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This is great we have detected the contour of the balloon. So, to 0, 255, 0 means b g r. So, g, so then the color of the contour becomes green. In case you want a red contour then, we instead of g channel to 255 we are going to set it to this to 255. So, this is going to make the contour to be red ok.

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It is as simple as that. So, so far what we have done is great we have identified the contour we have plotted the contour, now we have also want the area of the contour right. So, what is the area of the contour? So, thankfully we have functions which help us in finding out the area the perimeter of the contour.

So, its cv2.contourArea(contours[0]). So, this is the main contour in case you have other contours you have to give different indices like this, but because we have only one contour it is going to be contour[0].

We also have cv2.arcLength(contours[0], True) and we are going to give contours[0] right. So, these two should give us the area equals % f\t and length equal to % f\n. % we are going to call this ca and we are going to call this cl. So, then (ca, cl). So, let us see what happens when we run this let me close all the images. So, the argument is required ok.

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So, the arcLength also requires another argument which helps in telling whether it is a closed contour or an open contour. So, if it is a closed contour we have to tell True if it is an open contour we have to say false. So, the area is this and the arc length is this. Well great if you divided by  $2\pi$  you get the projected radius that is fine I am not going to do that because it is quite trivial to do what we have to do is to wrap all of this inside a for loop that is it ok.

We have to now wrap all of this inside the for loop and then, we are done sort of ok. Let me see whether I can invoke my plot lib.

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| 10                   | c1 = 1.5; c2 = -2; c3 = -0.1;   | Administrator: Clusindowslaythem321cmd.ase   |  |                   |
| 11<br>12             | <pre>isolated = cl*g + c2*b + c3*r;<br/>isolated = np.clip(isolated, 0, 255)</pre>  | (base) C:\Users\Admin\Dropbox  | \nptel_codes\lec41>python lec41.py   |                   |
| 13<br>14             | <pre>isolated = isolated.astype(img.dtype) cv2.imshow("mixed channel: before blurring", isolated)</pre>                                       | (base) C:\Users\Admin\Dropbox  | <pre>\nptel_codes\lec41&gt;python lec41.py</pre>                           |                   |
| 15<br>16             |   | (base) C:\Users\Admin\Dropbox  | <pre>\nptel_codes\lec41&gt;python lec41.py</pre>                           |                   |
| 17                   | <pre>imgblur = cv2.GaussianBlur(isolated, (9,9), 0);</pre>  | (base) C:\Users\Admin\Dropbox  | <pre>\nptel_codes\lec41&gt;python lec41.py</pre>                           |                   |
| 18                   | cv2.imsnow(-Arter blurring-, imgblur)   | (base) C:\Users\Admin\Dropbox  | <pre>\nptel_codes\lec41&gt;python lec41.py</pre>                           |                   |
| 20<br>21<br>22<br>23 | <pre>f Thresholdes the image<br/>ret, imgth = cv2.threshold(imgblur, 50, 255, cv2.THRESE_BIN<br/>cv2.imshow("Thresholded image", imgth)</pre> | (base) C:\Users\Admin\Dropbox<br>Traceback (most recent call 1<br>File "lec41.py", line 33, in | <pre>\nptel_codes\lec41&gt;python lec41.py ast): n <module></module></pre> |                   |
| 24<br>25             | <pre>edge = cv2.Canny(imgth, 100, 150);<br/>cv2.imshow("Edges of the image", edge);</pre>   | <pre>cl = cv2.arcLength(contou<br/>TypeError: arcLength() missin</pre>                         | rs[0])<br>g required argument 'closed' (pos 2                              |                   |
| 26<br>27             | contours, heirarchy = cv2.findContours(edge, cv2.RETR_EXTER<br>CHAIN_APPROX_NONE)   | (base) C:\Users\Admin\Dropbox<br>area=157072.500000 leng                                       | <pre>\nptel_codes\lec41&gt;python lec41.py th=1525.574805</pre>            |                   |
| 20<br>29<br>30<br>31 | <pre>cv2.drawContours(img, contours,0, (0, 0, 255), 3) cv2.imshow("image with contour", img); cv2.waitKey(0)</pre>                            | (base) C:\Users\Admin\Dropbox<br>area=157072.500000 leng                                       | <pre>\nptel_codes\lec41&gt;python lec41.py th=1525.574805</pre>            |                   |
| 32<br>33<br>34<br>35 | <pre>ca = cv2.contourArea(contours[0]) c1 = cv2.arcLength(contours[0], True) print("area+\$f\t length=\$f\n"\$(ca, cl));</pre>                | (base) C:\Users\Admin\Dropbox<br>area=157072.500000 leng                                       | <pre>\nptel_codes\lec41&gt;python lec41.py th=1525.574805</pre>            |                   |
| 36<br>37             | x = np.linspace(0,1): y = x**2: plt.plot(x, y)  | (base) C:\Users\Admin\Dropbox  | \nptel_codes\lec41>  |                   |
| 38<br>39 8<br>40     | <pre>while False:<br/>ret. img = vid.read()</pre>   |  |  | P.                |
| 41<br>42             | <pre>cv2.imshow("ballon deflate", img); cv2.waitKau(1)</pre>  | • the central also   | ment is replaced with this median value. This is                           | N                 |
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So, import matplotlib.pyplot as plt and x = np.linspace (0, 1),  $y = x^2$  here cannot plot x, y. So, let me see if it executes this in this because in, but it does not show the plot and that is ok. We can dump it to a file, we can read the file, later on no harm done ok. Let us not bother with this if you are using spider or something this will be very easy to do.

So, so far so good we have obtained this. Now we need to wrap everything. So, in order to wrap everything we will have to wrap all of this inside the appropriate program right.

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So, forget about this. So, we are going to say while True we are going to take all of this we are going to indent it alright.

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| 24          | ret, imgth = cv2.threshold(imgblur, 50, 255, cv2.THRE       | SH File "lec41.pv". line 33. in <module></module>                           |                 |
| 25          |   | <pre>cl = cv2.arcLength(contours[0])</pre>                                  |                 |
| 26          |   | TypeError: arcLength() missing required argument 'closed' (po               | s 2)            |
| 27          | edge = cv2.Canny(imgth, 100, 150);                          |   |                 |
| 28          |   | (base) C:\Users\Admin\Dropbox\nptel_codes\lec41>python lec41.               | ру              |
| 29          |   | area=157072.500000 length=1525.574805                                       |                 |
| 30          | contours, heirarchy = cv2.findContours(edge, cv2.RETR       | E   |                 |
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| 31          |   | (base) C:\Users\Admin\Dropbox\nptel_codes\lec41>python lec41.               | ру              |
| 32          | cv2.drawContours(img, contours,0, (0, 0, 255), 3)           | area=15/0/2.500000 length=1525.5/4805                                       |                 |
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| 36          | <pre>ca = cv2.contourArea(contours[0])</pre>                |   |                 |
| 37          | <pre>cl = cv2.arcLength(contours[0], True)</pre>            |   |                 |
| 38          | <pre>print("%f\t %f\n"%(ca, cl));</pre>                     | (base) C:\Users\Admin\Dropbox\nptel_codes\lec41>python lec41.               | py_             |
| 39          | cv2.waitKey(1)  |   |                 |
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And instead of writing down area and length if we going to simply output the percentage f I mean the area and the lengths. This waitKey we will make it as 1 and we are going to only show the last image we do not want to show the edges and all because in the end the manifestation of all that is through the red contour on the original image. So, the final image should be showing the balloon with the red contour alright.

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So, let us see what happens amazing. So, you can see that sometimes the internal thing is also showing. So, we need to find out a way of avoiding that internal thing I mean for the most of the part it does not really cause an issue perfect. So, for most of the part it does not cause an issue, but when it does cause an issue how do you get rid of that? Well, while printing the contour 0s as such you do not face an error ok.

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| 30         | contours, heirarchy = cv2.findContours(edge, cv2.RETR          | E File "lec41.          | py", line 10, in <module></module>                                   |         |
|            | CHAIN_APPROX_NONE)   | b, g, r =               | cv2.split(ing.astype(float))   |         |
| 31         |  | AttributeError          | : 'NoneType' object has no attribute 'astype'                        |         |
| 32         | cv2.drawContours(img, contours,0, (0, 0, 255), 3)              |                         |  |         |
| 33         | cv2.imshow("image with contour", img);                         | (base) C:\User          | <pre>s\Admin\Dropbox\nptel_codes\lec41&gt;python lec41.py</pre>      |         |
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| 35         |  |                         |  |         |
| 36         | ca = cv2.contourArea(contours[0])                              |                         |  |         |
| 37         | <pre>cl = cv2.arcLength(contours[0], True)</pre>               |                         |  |         |
| 38         | print("%f\t %f"%(ca, cl));                                     |                         |  |         |
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So, I tell you what, we are going to persist with this. Now how do you dump it to a file I am going to remove this percentage n.

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| 12       14       15.9977.800000       1519.977015         13       15.9977.800000       1551.95130         14       15.9977.800000       1551.95130         15       15.9977.800000       1551.95130         15       15.9977.800000       1551.95130         15       1551.951800       1551.95130         15       1557.9598000       1551.95130         15       1557.959800       1551.95130         15       1557.959800       1557.955980         15       1557.959800       1557.955980         15       1557.959800       1557.955980         15       1557.959800       1557.955980         1558.959800       1557.955980       1557.955980         1559.9559.9559       1559.9559         1559.9559.9559       1559.9559         1559.9559.9559       1559.9559         1559.9559.9559       1559.9559         1559.9559.9559       1559.9559         1559.9559.9559       1559.9559         1559.9559.9559       1559.9559         1559.9559.9559       1559.9559         1559.9559.9559       1559.9559         1559.9559       1559.9559         1559.9559       1559.9559  | M an agen   | n () Belage () Bannes () Belgie () Belgie () Belgie () Belgie () Belgie () Belgie () | Healing 3            | system321cmd.exe - python lec#1.py |  |        |
| 131       cl = 1.2; cl = -2; cl = -0.1;       15500.000000       1556.000000       1556.000000       1556.000000         15000.0000000       1554.000000       1554.000000       1554.000000       1554.000000       1554.000000         15000.0000000       1554.000000       1554.000000       1554.000000       1559.00000       1554.000000         15000.0000000       1554.000000       1554.000000       1554.000000       1557.000000       1557.000000         15000.0000000       1556.000000       1556.000000       1556.000000       1556.000000       156.000000         15000.0000000       156.000000       1556.000000       1557.000000       1557.000000       1558.000000       156.000000         15000.0000000       156.000000       156.000000       156.000000       1558.000000   |             |  | 155987 888888        | 1519 971015                        |  |        |
| 11  |             | c1 = 1.5; c2 = -2; c3 = -0.1;  | 157001 500000        | 1516 010597                        |  |        |
| 13<br>14<br>15<br>15<br>15<br>15<br>15<br>15<br>15<br>15<br>15<br>15  |             | image with contour   | 159937, 888888       | 1513.251327                        |  |        |
| 16 12 12 13 15 16 16 16 18 15 15 16 16 16 18 15 15 16 16 16 18 15 15 15 16 16 16 18 15 15 15 15 15 15 15 15 15 15 15 15 15  |             |  | 159882.888888        | 1524.684243                        |  |        |
| 17       114958.00000       1504.85447         19       15993.00000       1519.4513         19       15993.00000       1519.4513         20       15993.00000       1554.85130         21       1556.00000       155.6133         22       1566.00000       15.6.85351         23       1556.00000       15.6.85351         24       1566.00000       15.6.85351         25       1566.00000       15.6.85351         26       1566.00000       15.6.85351         27       1566.00000       151.8.3516         28       1566.00000       151.8.3516         29       1566.00000       151.8.3517         20       1566.00000       151.8.3517         21       1566.00000       151.8.3516         22       1557.000000       151.8.3517         23       1557.000000       151.8.3517         24       1557.0000000       155.6.46479         25       1557.0000000       156.00010         25       1557.0000000       156.00010         25       1557.0000000       156.00010         25       1557.0000000       156.00010         25       1557.0000000       1   |             |  | 1542,950000          | 1516.664884                        |  |        |
| 10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10  |             |  | 144890.000030        | 1560.589467                        |  |        |
| 19<br>19<br>20<br>21<br>21<br>22<br>22<br>23<br>24<br>25<br>24<br>25<br>25<br>25<br>25<br>25<br>25<br>25<br>25<br>25<br>25  |             |  | 168668.588888        | 1514.251141                        |  |        |
| 20       15794.30000       157.4.33313         22       1554.40113       158.40113         154.400000       158.40113       158.40113         154.400000       158.40113       158.40113         154.400000       158.40113       158.40113         154.400000       158.40113       158.40113         154.400000       157.40100       157.40100         154.4000000       157.40100       157.40100         154.417500000       158.41175       157.45100         154.417500000       158.41175       158.40175         15595.500000       158.41175       158.45514         15595.500000       158.41175       159.54514         15595.500000       159.54514       15908.60000       159.44515         15595.500000       159.557.45500       159.557.45500       159.57.45500         15595.500000       159.557.45500       159.557.45500       159.557.45500         15595.5000000       159.45471       159.557.45500       159.557.45500         15595.5000000       159.45475       159.557.45500       159.557.45500         15595.5000000       159.45475       159.557.45500       159.557.45500         15595.5000000       159.454755       159.557.455000       159.45  |             |  | 157993.000000        | 1519.783730                        |  |        |
| 21     135563,80000     155, 61113       22     1555,80000     15, 68531       23     155558,80000     15, 68531       24     156597,80000     151, 8555       25     156597,80000     151, 8557       26     156497,10000     151, 8557       27     156595,80000     151, 8557       28     156497,10000     151, 8557       29     155495,80000     151, 8557       29     155695,80000     151, 8557       29     15575,80000     153, 45475       29     15575,80000     154, 85548       30     15575,80000     155, 646475       31     15535,80000     155, 646475       32     15535,80000     155, 646475       33     15535,80000     155, 646475       34     15535,500000     155, 646475       35     15535,800000     156, 655248       36     15535,500000     156, 655248       37     15535,500000     1549, 89737       38     1557,50000000     1549, 89737       39     1557,5000000     1549, 89737       39     1549, 89737     1557,8000000       39     1549, 89737     1549, 89737       39     1549, 89737       39     1549, 89737  |             |  | 157994.500000        | 1517.785331                        |  |        |
| 1954. 400000         1958. 453331           23         1954. 400000         195. 433314           23         195. 563331         195. 563331           24         195.6680000         147. 883314           25.668.00000         147. 883314         195.00000           25.441.7500000         1518. 94301         195.00000           25.441.7500000         1518.94301         195.00000           26.441.7500000         1518.943101         195.00000           27.7         195.00000         1518.943174           28.9000         1518.943174         195.00000           29.957.000000         154.117478         195.057.000000           29.957.0000000         1551.44475         15500000           29.957.0000000         1551.44475         155000000           29.957.0000000         1551.44475         155000000           29.957.0000000         1551.44475         15501.950000           29.9577.0000000         1551.44475         15501.950000           29.9577.00000000         1551.44475         15501.950000           29.9577.00000000         1551.44475         15501.950000           29.9577.00000000         1551.44475         1551.750000000           29.9577.00000000         1551.44475  |             |  | 155983.000000        | 1526.261773                        |  |        |
| 23         15455300000         15, 6, 83514           24         15555450000         151, 6, 95454           24         15659450000         151, 8, 95454           25         154697100000         151, 8, 95454           26         154697100000         151, 8, 95454           27         15659530000         151, 8, 95455           28         154697500000         151, 8, 95475           29         155695300000         151, 8, 95475           29         155695300000         151, 8, 95475           29         155695300000         151, 8, 95475           29         155695300000         154, 8, 95456           151, 9550500000         154, 95456         1557, 9560000           151, 9550500000         1554, 94575         155354, 960000           151, 9550500000         1554, 94575         155354, 960000         156, 956270           303         1553534, 960000         15469, 93737         1553, 9600000         15469, 93737           303         1553754, 9600000         15469, 93737         1553, 9600000         15469, 93737           303         155374, 9600000         15469, 93737         1553, 9600000         15469, 93737           303         155374, 96000000         15469, 93737 </td <td></td> <td></td> <td>1562.000000</td> <td>158.361531</td> <td></td> <td></td>  |             |  | 1562.000000          | 158.361531                         |  |        |
| 24         153545.40000         147.833314           25         155.60000         155.8516           26         154.712000         155.45100           27         159.0000         158.41176           28         159.0000         158.41176           29         159.0000         158.41176           29         159.0000         158.41176           29         159.0000         159.118.1016           29         159.0000         159.118.1016           29         159.0000         159.117.41176           29         159.0000         159.117.1174           29         159.0000         159.117.1174           20         159.00000         159.1174.1174           20         159.00000         159.00000           20         159.00000         159.00000           215.000000         159.00000         159.00000           215.0000000         159.00000         159.00000           215.0000000         159.000000         159.00000           215.00000000         159.000000         159.000000           215.00000000         159.000000         159.000000           215.00000000         159.0000000000000000         159.0000000000000000000000000   |             |  | 156890000000         | 15.6.888514                        |  |        |
| 44         156000000000000000000000000000000000000  |             |  | 153456.000000        | 1417.888514                        |  |        |
| 42         154-72100000         1517.4451000           22         154-72100000         1518.35206           23         155935.50000         1518.41575           23         155925.60000         154.712769           33         155724.60000         150.172769           33         155925.60000         1557.44575           33         155925.60000         1559.44475           33         155925.60000         1559.44475           33         155925.60000         1559.44475           33         155925.60000         159.40075           34         155995.700000         159.4075           35         155995.60000         150.44975           36         155995.60000         150.44975           37         1559.577.45904         150.459125           38         155995.60000         150.459125           39         153.757.600000         1560.95757           39         153.757.600000         156.4591575           39         153.757.600000         156.4591575           39         153.757.500000         156.4591575           39         153.757.500000         156.4591575   |             |  | 1562289500000        | 1518.995855                        |  |        |
| 24         154487500000         1513.35256           25         153805.300000         1534.37257           28         153805.300000         1534.37257           29         153805.300000         1544.372500           30         15357.300000         1554.34257           31         15395.300000         1554.44275           32         15395.300000         1554.44275           33         15395.300000         1557.44275           34         15395.300000         1557.45275           35         1557.35395.000000         1557.45375           34         15595.3000000         1554.45275           35         15575.3539.400000         1554.35175           36         15575.35000000         1554.35175           37         15575.400000         15448.35739           38         15575.200000         15448.35739           39         1547.2000000         15448.35739           39         1549.400000         15448.39739           39         1549.400000         15448.39739           39         1549.400000         15448.39739           39         1549.400000         15448.39739           39         1549.4000000         15448.3000000   |             |  | 1543721000800        | 1517.485300                        |  |        |
| 27         154903 Seeeee         1518. 44195           28         155903 Seeeee         1518. 44195           29         155903 Seeeee         1541. 712419           30         155704 Seeeee         1541. 712419           31         157702 Seeeee         1551. 45435           33         153908 Aeeeee         1557. 45436           333         153908 Aeeeee         1557. 45436           334         153908 Aeeeeee         1557. 45436           335         153908 Aeeeeee         1557. 45436           336         153908 Aeeeeee         1557. 45436           337         15391. 36980e         1561. 951735           336         15395. 46980e         1561. 951735           337         15391. 36980e         1561. 951735           336         15397. 45980e         1561. 951735           337         1539. 46980e         1561. 951735           337         1539. 46980e         1561. 951735           338         1539. 45980e         1561. 951735           337         1539. 46980e         1561. 951735           338         1539. 45980e         1561. 951755           337         1539. 46980e         1561. 951755           338 <td< td=""><td></td><td></td><td>1544857500000</td><td>1511.332504</td><td></td><td></td></td<>  |             |  | 1544857500000        | 1511.332504                        |  |        |
| 28<br>29<br>30<br>31<br>32<br>33<br>34<br>35<br>34<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35<br>35  |             |  | 156985.900000        | 1518.341376                        |  |        |
| 29<br>30<br>31<br>32<br>33<br>33<br>34<br>35<br>35<br>36<br>36<br>37<br>36<br>36<br>37<br>37<br>36<br>36<br>37<br>37<br>38<br>38<br>39<br>39<br>39<br>39<br>39<br>39<br>39<br>39<br>39<br>39  |             |  | 166365.600000        | 1536.788534                        |  |        |
| 30         153572-500000         1532.45355           31         153722-500000         156.400007           32         153722-500000         156.5552.4243           33         153932-500000         156.552.4247           34         153932-500000         1567.435964           35         153732-500000         1567.435964           36         153932-500000         1578.439729           36         153932-500000         1578.438729           37         153932-500000         1554358739           38         153992-600000         1554358739           39         1549.93979         15469.93979  |             |  | 157008.000000        | 1541.274670                        |  |        |
| 14600000         6.00004           31         15702.500000         1555.64473           32         15308.80000         1557.64473           33         15331.60000         1592.60001           34         15305.80000         1592.60001           35         15335.80000         1592.692121           35         15337.80000         1592.692123           36         15337.80000         1592.692123           37         15337.80000         1592.692123           38         15937.70200000         1592.692733           38         15937.70200000         1562.93737           38         15407.70200000         15469.9373*           39         1543.005373         1543.005373           39         1543.005373         1543.005373*   |             |  | 155572.500000        | 1528.519456                        |  |        |
| 31         Li 5722. Soeeee         154. 555/348           32         Li 5722. Soeeeee         155. 46473           33         Li 5922. Soeeeee         1557. 46473           34         Li 5935. Soeeee         1557. 46473           35         Li 5935. Soeeeee         1557. 46473           36         Li 5935. Soeeeee         1578. 583729           35         Li 5935. Soeeeee         1554.580759           36         Li 5935. Soeeeee         15465.9373*           37         Li 5170.00000e         15465.9373*           38         Li 5936.0000e         15465.9373*           39         Li 19. Ker. dl. Li 19. Col. M. 100         Madw. Clittl. (19.4)         pct           were         Wept 101 Nov. dl. Li 19. Col. M. 100         Madw. Clittl. (19.4)         pct         1   |             |  | 14500000             | 0.000064                           |  |        |
| 32         13 3988.80000         1557.444779           33         15331.600000         1592.444779           34         15393.1.600000         1592.444779           35         15397.800000         1592.444779           35         15397.800000         1592.444779           35         15397.800000         1592.444779           36         15397.800000         1592.411244           1537.770200000         1545.93395779           36         1547.770200000         1546.93737*           37         1533.40500000         1546.93737*           38         1549.76920000         1546.93737*   |             |  | 153782.500000        | 158.5545248                        |  |        |
| 33         15331.500000         1557.43924           34         15392.500000         1557.43924           35         15373.500000         1578.59124           36         15373.500000         15543.00179           37         15170200000         15543.00179           38         15170200000         15543.00179           36         15469.3373         15543.00179           36         15469.3373         15543.00179           37         15170200000         15469.3373*           38         15469.3373*         15669.000           39         15469.000         15469.000           30         15469.000         15469.000           31         15469.000         15469.000           32         15469.000         15469.000           33         15469.000         15469.000           34         15469.000         15469.000           34         15469.000         15469.000           35         15469.000         15469.000           34         15469.000         15469.000           35         15469.000         15469.000           36         15469.000         15469.000           37         15469.000 <td></td> <td></td> <td>153000.000000</td> <td>1552.684879</td> <td></td> <td></td>  |             |  | 153000.000000        | 1552.684879                        |  |        |
| 34         153995 500000         1502.699212           35         153935 4000000         1502.699212           36         153935 4000000         1562.991210           37         153935 4000000         1562.991210           38         1537270200000         1562.991270           38         1537.972020000         1562.991270           38         1533.000000         1564.991270           39         1533.0000000         1564.991270           39         1533.0000000         1564.991270           39         1533.0000000         1564.991270           39         1533.00000000         1564.991270           39         1533.00000000         1564.991270           39         1533.0000000000         1564.991270           39         1533.0000000000         1564.991270           30         159.000000000000000000000000000000000000  |             |  | 153341.500000        | 1557.489504                        |  |        |
| 33         153332.400000         1578.839726           36         153332.600000         15464.901736           37         155470200000         15464.901730           38         15392.600000         15464.901730           39         154.00000         15464.91730           30         154.000000         15464.91730           30         154.000000         15464.91730           30         154.000000         15464.91730           30         154.0000000         15464.91730           30         154.0000000         15464.91730           30         154.00000000         15464.91700           30         154.000000000000000000000000000000000000   |             |  | 153095.500000        | 1502.689321                        |  |        |
| 36         153393-500000         15614711184           37         15337-2000000         15644930759           38         1543.000000         15466.93730           39         1543.000000         15466.93730           40         1         1           41         1         1           42         1         1           43         1         1           43         1         1           43         1         1           43         1         1           43         1         1           43         1         1           43         1         1           43         1         1           44         1         1           45         1         1           46         1         1           47         1         1           48         1         1           49         1         1           49         1         1           40         1         1           41         1         1           42         1         1           43   |             |  | 153584.000000        | 1578.989729                        |  |        |
| 37         151726200000         15543480759           38         155467.83759           38         15667.83759           38         15667.83759           38         15667.83759           38         15667.83759           38         15667.83759           38         15667.83759           38         15667.83759           38         15667.83759           39         15667.83759           39         15667.83759           39         15667.83759           39         15667.83759           39         15667.83759           39         15667.83759           39         15667.83759           39         15667.83759           39         15667.83759           30         15667.83759           30         15667.83759           30         15667.83759           30         15667.83759           30         15667.83759           30         15667.83759           30         15667.83759           30         15667.83759           30         15667.83759           30         15667.83759           30   |             |  | 153936.500000        | 1561911184                         |  |        |
| 33<br>35<br>40<br>41<br>42<br>43<br>40<br>41<br>42<br>43<br>40<br>40<br>40<br>40<br>40<br>40<br>40<br>40<br>40<br>40<br>40<br>40<br>40  |             |  | 15270288888          | 15549305759                        |  |        |
| 23<br>44<br>42<br>42<br>43<br>44<br>42<br>43<br>44<br>42<br>43<br>44<br>42<br>43<br>44<br>42<br>45<br>44<br>45<br>45<br>46<br>45<br>45<br>46<br>45<br>45<br>46<br>45<br>45<br>45<br>45<br>45<br>45<br>45<br>45<br>45<br>45  |             |  | 1535.00500000        | 15469.9373%                        |  |        |
| 57<br>41<br>42<br>42<br>47<br>47<br>47<br>47<br>47<br>47<br>47<br>47<br>47<br>47  | 20          |  |                      |                                    |  |        |
| 42<br>42<br>43<br>Another Market And Another And Another Anothe | 40          |  |                      |                                    |  |        |
| 42<br>43<br>mm/m wph-140 lose (6 Lo 10 Cet 54 10) mm/m C010 1074 36 <sup>-1</sup> the central element is replaced with this median value. This is   |             |  |                      |                                    |  | B. (B) |
| 23<br>34<br>Another Sector 10 Another Sector 10 Anot      |             |  |                      |                                    |  |        |
| st method with the method with the method with the method value. This is  |             |  |                      |                                    |  | PA .   |
| yter file length: (165 lines: 40 lise: 30 clinit Sch 5) 10 linebox; (21.0) UF-4 ks 3 the central element is replaced with this median value. This is  |             |  |                      |                                    |  |        |
|   | otherafile  | Januth 1145 Januar 43 Jan 35 Col-6 Sel-010   | Weekees (CR18) 1/5-8 | the central element is r           | replaced with this median value. This is |        |
|   |             |  |                      |                                    |  |        |

# (Refer Slide Time: 12:39)



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| THE FOR THE DC B & ST DE BISTON ST FE   |                          |                                    | D CARL C A                          |   |
| Ballin Marco C. Barder C. Barder C. Barder C. Barder C. Barder C. Brance C. | Administrator Clyvindows | system321cmd.exe - python lec41.py |                                     |   |
| 12 channel mixing   | 14442884488              | 1596.461488                        |                                     |   |
| <pre>13 c1 = 1.5; c2 = -2; c3 = -0.1;</pre>   | 165695.600000            | 1496.993915                        |                                     |   |
| 14 📰 intersition  | 151688.500000            | 1495.091514                        |                                     |   |
| 15  | 152949.000000            | 1584.587738                        |                                     |   |
| 16  | 1472.500000              | 111,781765                         |                                     |   |
| 17  | 143398.500000            | 1591.746179                        |                                     |   |
| 18  | 143774.598888            | 1593.417951                        |                                     |   |
| 19  | 153876.000000            | 1497.475311                        |                                     |   |
| 20  | 153852.000000            | 1502.475319                        |                                     |   |
| 21  | 154423.500000            | 1498e7,3829                        |                                     |   |
| 22  | 154909600000             | 1524e704748                        |                                     |   |
| 23  | 154949.000000            | 1597-190029                        |                                     |   |
| 24  | 154084.000000            | 159255~3758                        |                                     |   |
| 27  | 143084.000000            | 150655-3758                        |                                     |   |
| 20  | 1:20010500000            | 1499543247 <b>8</b>                |                                     |   |
| 20  | 2:15318                  | 84095200538                        |                                     |   |
| 21  | 15145238888888           | 1488 7 1748                        |                                     |   |
| 28  | 14974978888              | 14873533175                        |                                     |   |
| 29  | 1494497000000            | 14855847894                        |                                     |   |
| 30  | 1588427000000            | 14835675311                        |                                     |   |
|   | 1351427000000            | 14805361602                        |                                     |   |
| 31  | 1456-0221000             | 152.789945                         |                                     |   |
| 32  | 145136000000             | 1412.299447                        |                                     |   |
| 33  | 1445,520000              | 150.914893                         |                                     |   |
| 34  | 145886,000000            | 1314.999457                        |                                     |   |
| 35  | 1444.00000               | 138.367591                         |                                     |   |
| 36  | 148054.800000            | 1498.503938                        |                                     |   |
| 37  | 147461.500000            | 1432.493198                        |                                     |   |
| 38  | 148424.000000            | 1483.190939                        |                                     | 1 S S S S S S S S S S S S S S S S S S S |
| 39  |                          |                                    |                                     |   |
| 40  |                          |                                    |                                     |   |
| 41  |                          |                                    |                                     | ( BUSI                                  |
|   |                          |                                    |                                     | C STOR                                  |
| 10  |                          |                                    |                                     | Sec. 1                                  |
|   |                          |                                    |                                     | 51                                      |
| Define file (and) 135 (and (2) (and (2) (a))  | Mindows (1919) 1/5-8     | the central element is repla       | ced with this median value. This is |   |
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## (Refer Slide Time: 12:44)



(Refer Slide Time: 12:52)

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|           |  | 41212.500000                    | 778.222431   |                                   |         |
|           | c1 = 1.5; c2 = -2; c3 = -0.1;  | 39653.000000                    | 767,979791   |                                   |         |
|           | isolated = cl*g + c2*b + c3*r;   | 37988.000000                    | 759.979791   |                                   |         |
|           | isolated = np.clip(isolated, 0, 255)   | 36259.000000                    | 749.837655   |                                   |         |
|           | <pre>isolated = isolated.astype(img.dtype)</pre>   | 34610.000000                    | 744.180801   |                                   |         |
|           |  | 32653.000000                    | 738.523947   |                                   |         |
|           |  | 31135.000000                    | 727.695520   |                                   |         |
|           |  | 30232.000000                    | 724.867093   |                                   |         |
|           | <pre>impblur = cv2.GaussianBlur(isolated, (9.9), 0);</pre>   | 29545.500000                    | 720.624452   |                                   |         |
|           |  | 28776.000000                    | 711.553385   |                                   |         |
|           |  | 27983.500000                    | 698.825463   |                                   |         |
|           |  | 26976.000000                    | 683.754395   |                                   |         |
|           | ret imath = cu2 threshold(imahlur 50 255 cm2 780   | 25801.000000                    | 658.298551   |                                   |         |
|           | iet, ingen - overentesnord(ingerit, so, cos, overing   | 24440.500000                    | 627.771640   |                                   |         |
| 2         |  | 22856.000000                    | 575.102593   |                                   |         |
| •         | adam a sub descentioneth (100) (100)   | 21369.000000                    | 553.931020   |                                   |         |
|           | edge = cv2.Canny(imgth, 100, 150);   | 20313.500000                    | 542.859953   |                                   |         |
| 8         |  | 20333.500000                    | 557.002088   |                                   |         |
|           |  | 21427.500000                    | 588.193661   |                                   |         |
|           | contours, heirarchy = cv2.findContours(edge, cv2.RET   | R_E22100.000000                 | 621.185853   |                                   |         |
|           | CHAIN_APPROX_NONE)   | 21118.500000                    | 689.428494   |                                   |         |
|           |  | 21408.500000                    | 615.712765   |                                   |         |
|           | cv2.drawContours(img, contours,0, (0, 0, 255), 3)  | 22228.000000                    | 628.925968   |                                   |         |
|           | cv2.imshow("image with contour", img);   | 21659.500000                    | 621.026473   |                                   |         |
|           |  | Traceback (mos                  | recent call last):   |                                   |         |
|           |  | File -lec41.                    | by , line 10, in <module></module>   |                                   |         |
|           | <pre>ca = cv2.contourArea(contours[0])</pre>   | b, g, r = 1                     | v2.split(img.astype(float  |                                   |         |
|           | <pre>cl = cv2.arcLength(contours[0], True)</pre>   | AttributeError                  | Nonelype object has no   | o attribute "astype"              |         |
|           | print("\$f\t \$f"%(ca. cl)):   | thereas a survey                |  |                                   |         |
| 9         | Arry partmants   | (dase) C:\User                  | <pre>s\Admin\Uropbox\nptel_code</pre>  | 25 \1ec41>                        |         |
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| 3         |  |                                 |  |                                   |         |
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| 0.        |  |                                 | and the second s |                                   |         |

I am going to remove this because I do not want to see the image. I just want to look at the values on the command line ok. Sometimes you do have that small contour appearing right. So, let us try to fix that let us try to fix that alright this code execute alright. So, over here we have the contours and the hierarchy now we need to extract the largest contour ok.

### (Refer Slide Time: 13:17)

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|          |   | 155763.000000               | 1514.989019   |
|          | $C_1 = 1.3$ ; $C_2 = -2$ ; $C_3 = -0.1$ ;   | 155206.000000               | 1507.047894   |
|          | 1801ated = c1*g + c2*b + c3*1;  | 154836.000000               | 1508.018456   |
|          | isolated = np.clip(isolated, 0, 255)  | 154321.500000               | 1513.432670   |
|          | isolated = isolated.astype(img.dtype)   | 154056.000000               | 1504.989019   |
|          |   | 153450.000000               | 1498.018456   |
|          |   | 152276.500000               | 1489.290535   |
|          |   | 150785.000000               | 1480.219467   |
|          | <pre>imgblur = cv2.GaussianBlur(isolated, (9,9), 0);</pre>  | 149346.000000               | 1473.047894   |
|          |   | 147761.000000               | 1458.905759   |
|          |   | 146155.000000               | 1464.562613   |
|          |   | 144732.000000               | 1454.763623   |
|          | rat imath = cu2 threshold(imablur 50 255 cm2 700  | 143880.000000               | 1448.420477   |
|          | Tee, ingen - everenteshold(ingeldt, se, ess, evering  | 1372.500000                 | 146,124898  |
|          |   | 141768.000000               | 1440.552613   |
|          |   | 140878.000000               | 1431.592050   |
|          | edge = cv2.Canny(imgth, 100, 150);  | 139898.000000               | 1427.248984   |
|          |   | 139380.000000               | 1426.077332   |
|          |   | 139229.000000               | 1422.077332   |
|          | contours, heirarchy = cv2.findContours(edge, cv2.RET  | R E139017.500000            | 1424.462188   |
|          | CHAIN APPROX NONE   | 138923.500000               | 1437.692556   |
|          |   | 138835.000000               | 1433.391040   |
| 32       | cv2.drawContours(img, contours.0, (0, 0, 255), 3)   | 1437.00000                  | 149.539184  |
|          | cv2 imshow/"image with contour", img);  | 137891.500000               | 1417.834691   |
|          | orereased anage water concour ( ang) (  | 138014.000000               | 1424.077332   |
|          |   | 137947.000000               | 1417.248984   |
|          |   | 137648.000000               | 1415.248984   |
|          | ca = cv2.contourarea(contours[0])   | 137337.000000               | 1416.763623   |
|          | <pre>cl = cv2.arcLength(contours[0], True)</pre>  | 136942.000000               | 1413.592050   |
|          | <pre>print("%f\t %f"%(ca, cl));</pre>   | 136084.000000               | 1407.449915   |
|          |   |                             |   |
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So, before that let us see some whether we can find some common trend, when we have the smaller contour the area of that smaller contour is quite small. So, it is like 1372, 1445, 1451 and so on. So, the larger contour is significantly larger than the smaller contour. So, that gives us a clue on how we can isolate the larger contour ok.

(Refer Slide Time: 13:49)



So, once we have obtained the contours we are going to take the contours and convert it to a list contours equal to list contours after converting it to a list. Let us take the selected contour or let us take the 0th contour and assign it to a selected contour. So, in the end the selected contour will be the largest contour, but we can assign selected contour default as the 0th contours 0 ok dot copy we going to make a copy of it.

So, now for contour in contours that is it will loop over the different i ds of the contours. We will say if if cv2.contourArea(contour) > 2000 then selectedcontour = contour alright. So, it means that if that particular contour is having, so this is basically initialization of the variable initialization of the variable. It has I mean you could do without this as well.

Then once you have initialized if you find the contour in the contours list which has an area larger than 2000 you make it as a related contour. Well 2000 also I mean we could make it very well as 3000, well towards the end what is the area let us see. We do not want to discard those towards the end it is 21000. So, we can make it 3000 as well.

So, then it is the selected contour and once we found this, we want to plot only the selected contour. So, contours comma ok as so it turns out when I was using a smaller kernel for the Gaussian blur that is the smaller area for the Gaussian blur it was giving me lot of isolated contours as well.

(Refer Slide Time: 16:15)

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|               |  | 142842.000000              | 1448.846884                       |                       |        |
|               |  | 142881.000000              | 1451.332165                       |                       |        |
|               | c1 = 1.5; c2 = -2; c3 = -0.1;  | 142798.500000              | 1450.462108                       |                       |        |
|               | <pre>isolated = cl*g + c2*b + c3*r;</pre>  | 143101.500000              | 1461.432670                       |                       |        |
|               | isolated = np.clip(isolated, 0, 255)   | 143741.500000              | 1447.633680                       |                       |        |
|               | isolated = isolated.astype(img.dtype)  | 144363.000000              | 1452.704748                       |                       |        |
|               |  | 145269.500000              | 1457.148399                       |                       |        |
|               |  | 145817.500000              | 1456.319972                       |                       |        |
|               |  | 146396.500000              | 1452.805253                       |                       |        |
|               | <pre>imgblur = cv2.GaussianBlur(isolated, (9,9), 0);</pre>   | 146840.000000              | 1465.190029                       |                       |        |
|               |  | 146659.500000              | 1472.261097                       |                       |        |
|               |  | 146777.500000              | 1463.148399                       |                       |        |
|               |  | 147279.500000              | 1464.118962                       |                       |        |
|               | ret imath = cw2 threshold(imablur 80, 255, cw2 THPES   | 147809.500000              | 1462.118962                       |                       |        |
|               | <pre>ker2 insheu/#2brasholdad inana* insth)</pre>  | 147913.500000              | 1462.462108                       |                       |        |
|               |  | 147465.000000              | 1465.533175                       |                       |        |
|               | CALL CONTRACTOR AND AND AND AND A  | 146735.000000              | 1463.533175                       |                       |        |
|               | <pre>edge = cv2.canny(imgth, 100, 150);</pre>  | 145696.000000              | 1455.876321                       |                       |        |
| 28            | cv2.1mshow("Edges of the image", edge);  | 144653.500000              | 1459.633680                       |                       |        |
| 29            | cv2.waitKey(0)   | 144228.000000              | 1449.391040                       |                       |        |
|               | contours, heirarchy = cv2.findContours(edge, cv2.RETR_   | E143443.000000             | 1441.248904                       |                       |        |
|               | CHAIN_APPROX_NONE)   | 142760.500000              | 1441.976826                       |                       |        |
|               |  | 140858.000000              | 1446.361602                       |                       |        |
|               | contours = list(contours)  | 139724.500000              | 1435.775816                       |                       |        |
|               | selectedcontour = contours[0].copy # Initialization of th  | Traceback (most            | recent call last):                |                       |        |
|               | for contour in contoura:   | File "lec41.p              | y", line 27, in <module></module> |                       |        |
|               | if cv2.contourArea(contour) > 2000:  | edge = cv2.                | Canny(imgth, 100, 150);           |                       |        |
|               | selected contour = contour   | KeyboardInterru            | ipt                               |                       |        |
|               |  |                            |                                   |                       |        |
|               |  | (base) C:\Users            | \Admin\Dropbox\nptel_codes\le     | ec41>python lec41.py  |        |
|               | cv2.drawconcours(img, np.array([selectedconcour]),0, (   |                            |                                   |                       |        |
|               | cv2.imshow("image with contour", img);   |                            |                                   |                       |        |
|               |  |                            |                                   |                       | X      |
|               |  |                            |                                   |                       | -5-    |
|               | <pre>ca = cv2.contourArea(contours[0])</pre>   |                            |                                   | nCV/OnenCV            | C      |
| 438           | cl = cs2 arclanath(contours(0) True)   |                            |                                   | ILVUDENLA             | 1      |
| ythen the     | tengn: (42 tens:47 En:27 Col:5 Sel:0)0 Windo   | R (LKD) UN-6               |                                   |                       |        |
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So, let me show you what I mean let me make it make the kernel size as 9 and let me show you the edge detected after making the kernel size 9.

### (Refer Slide Time: 16:29)



So, let me run this. So, if you look closely I am not sure I will be able to zoom it go ahead there is a small contour pocket near this which is not actually joined ok and that gives us a bunch of broken contours which are not helping our cause.

(Refer Slide Time: 16:52)



So, we need to blur it with a larger kernel here in this case its 21 after blurring we will remove those isolated pockets its more smooth now ok.

#### (Refer Slide Time: 16:58)



So, let me stop this. So, let me comment out the ok. So, what happens is you have the selected contour initialized in the contourArea is larger than 2000 you make the contour to be in the selected contour then you cast it to the form of an array and you plot the contour on top of the image.

(Refer Slide Time: 17:30)

| <pre>c use we we have a set of the control theory is a control theory is control theory is control theory</pre>  | Chilbert Adm     | an Ørsphanlegtet, under Hiller 47 des Hiller y - Nampado -       |                            | ×   | - 0 X    |
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| <pre>14473.500000 1455.07501 1mgblur = v72.GaussianBlur(isolated, (21,21), 0); 14465.500000 1455.07501 1mgblur = v72.GaussianBlur(isolated, (21,21), 0); 14465.500000 1455.07501 1444.1565.00000 1455.07501 1444.150000 1444.15000 1444.15000 1444.15000 1444.15000 1444.15000 1444.15000 1444.15000 1444.15000 1444.1500 1440.1500 1440.15000 1440.150 1440.15 1440.15 14</pre>   | 17               |  | 147465.000000              | 1465.533175   |          |
| <pre>14455.500000 1455.77521 14455.500000 1455.77521 14455.500000 1455.75525 14452.500000 1455.75525 14452.500000 1455.75525 14452.500000 1455.75525 14452.50000 1455.75525 14452.50000 1455.75525 1457.50000 1457.555 1457.50000 1457.555 1457.50000 1457.555 1457.50000 1457.555 1457.50000 1457.555 1457.50000 1457.555 1457.50000 1457.555 1457.50000 1457.555 1457.50000 1457.555 1457.50000 1457.555 1457.50000 1457.555 1457.50000 1457.555 1457.50000 1457.555 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 1457.55 1457.50000 147</pre>   | 18               |  | 146735.000000              | 1463.533175   |          |
| <pre>implor = cv2.contourAres(contours) / implor<br/>implor = cv2.contourAres(contours) / contours<br/>implor = cv2.contourAres(contours) / contours / contours(contours) / contours(contours) / contours(contours) / contours(contours) / contours) / contours / contours<br/>implor = cv2.contourAres(contours) / contours / contours(contours) / contours / con</pre>   | 19               | ₹ gaussian biur  | 145696.000000              | 1455.876321   |          |
| <pre>tork.imade("tates herring" implet)</pre>  | 20               | <pre>imgDlur = cv2.GaussianBlur(isolated, (21,21), 0);</pre>     | 144653.500000              | 1459.633680   |          |
| <pre>1444.368680 1441.348684 1441.348684 1441.348684 1441.348684 1441.348684 1441.348684 1441.348684 1441.348684 1441.348684 1441.348684 1441.348684 1441.348684 1441.348684 1441.348684 1441.348684 1441.34868 1441.34868 1441.34868 1441.34868 1441.34868 1441.34868 1441.34868 1441.34868 1441.34868 1441.3486 1441.3486 1441.348 1441.34 1441.34 1441.34 1441.34 1441.34 1441.34 1441.34</pre>  | 21               |  | 144228.000000              | 1449.391040   |          |
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| <pre>144 ref.imp(" here(here() file() file()</pre>   | 23               |  | 142768.500000              | 1441.976826   |          |
| <pre>text.imbourthmeanLabelings.phagebi text.imbourthmeanLabelings.phagebi text.imbour</pre>   | 24               | ret, imgth = cv2.threshold(imgblur, 80, 255, cv2.THRE            | ESH140858.000000           | 1446.361682   |          |
| <pre></pre>  | 25               |  | 139/24.500000              | 1435.//5816   |          |
| <pre>27 edge = v2.Comp(ingth, 100, 100);</pre>   | 26               |  | Traceback (mos             | t recent call last):  |          |
| <pre>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourtings::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::<br/>tecl.tambourting::</pre>  | 27               | edge = cv2.Canny(imgth, 100, 150);                               | File lec41.                | py , line 2/, in <module></module>                              |          |
| <pre>     tert.mittey10</pre>  | 28               |  | eoge = cv2                 | .canny(imgth, 100, 150);  |          |
| <pre>contours, beitrarchy = cv2.findContours(edge, cv2.EETE F_Gusg) (:WusersMadeinTorphotNytel_CodeXlet4Jpython let41.py<br/>CHAIN_REPORT_NORE)</pre>  | 29               |  | AP AP                      | upc   |          |
| CHAIL AFFROX_SORE) CHAIL AFFROX_   | 30               | contours, heirarchy = cv2.findContours(edge, cv2.RETE            | RE(hase) Cilling           | s\idmin\Dronhov\nntal_codas\lacdl\nuthon_lacd1_nu               |          |
| <pre>if if i</pre>  |                  | CHAIN APPROX NONE)   | Traceback (mos             | t recent call lact)   |          |
| <pre>contours = list (contours)</pre>  | 31               |  | File "lec41.               | nv" line 38 in (module)   |          |
| <pre>selectedonotour = contours() copy # hit/siztime of the Typefror: contours is not a numpy array, meither a staler<br/>for contour is contours:<br/>selectedonotour = contours() &gt; 2000;<br/>selectedonotour = contours() &gt; 2000;<br/>selectedonotour = contours() &gt; 2000;<br/>cv2.imstow() (selectedonotour) &gt; 2000;<br/>cv2.imstow() (selectedonotour) () () () () () () () () () () () () ()</pre>   | 32               | contours = list(contours)  | cv2.drauCo                 | ntours(img. np.arrav([selectedcontour]).0. (0. 0.               | 255), 3) |
| <pre>fer contour: is contours:<br/>if ev2.contourines(contours) &gt; 2000;<br/>salectedoatours:</pre>  | 33               | selectedcontour = contours[0].copy # Initialization of b         | the TypeError: cor         | tours is not a numpy array, neither a scalar                    |          |
| <pre>1</pre>   | 34 8             | for contour in contours:   |                            |   |          |
| selectedcontour = contour<br>ise27.3eeeee _if4.jpy, line 18;<br>cv2.drawContours(ing, np.array([selectedcontour]), 0, (0 file *let1, py*, line 18; in (sodule)<br>cv2.ishbow(*isage with contour*, isp);<br>seyboardInterrupt<br>cc<br>a = cv2.contourArea (contours(0))<br>cl = cv2.archapth(contours(0), frue)<br>print(*&f(t & f*&(ch, cl));<br>cv2.witkey(i)<br>between _upt(18 becd _ ur3 Grid Grid _ under(0)) (%  | 35 8             | if cv2.contourArea(contour) > 2000:                              | (base) C:\User             | s\Admin\Dropbox\nptel_codes\lec41>python lec41.py               |          |
| 77     Trickback (not recent call lat):       78     cv2.distroutours(ling, np.array ([selectedcontour])), 0, 0 (P ile 'let');       78     cv2.distrout'linge with contours(in);       78     cv2.distrout'linge with contours(in);       78     cv2.distrout'linge with contours(in);       78     cv2.distrout'linge with contours(in);       78     cv2.witkey(0)       78     cv2.witkey(1)       78     cv2.witkey(1)       78     cv2.witkey(1)       78     cv2.witkey(1)       78     cv2.witkey(1)   | 36 -             | selectedcontour = contour  | 150257.000000              | 1474.784748   |          |
| 38     cv2.drawContours(img, np.array([selectedcontour]), (), ()     file*lec1, py*, in 28, in cmc0ule>       39     cv2.drawContours(img, np.array([selectedcontour]), (), ()     file*lec1, py*, in 28, in cmc0ule>       39     cv2.drawContours(img, np.array([selectedcontour]), (), ()     file*lec1, py*, in 28, in cmc0ule>       41     cv2.drawContours(img, np.array([selectedcontour]))     file*lec1, py*, in 28, in cmc0ule>       42     cv2.drawContours(img, np.array([selectedcontour]))     file*lec1, py*, in 28, in cmc0ule>       41     cv2.drawContours(img, np.array([selectedcontour]))     file*lec1, py*, in 28, in cmc0ule>       42     cs     cv2.drawContours(img, np.array([selectedcontour]))       43     cl = cv2.archapth(contours(0)), True)     is8257.888888       44     print(*%file*lec4, cl));     cv2.waitKey(i)       45     print(*%file*lec4, cl));     file*lec4, py       46     is8.     file*lec4, py       47     is8.     file*lec4, py       48     is8.     file*lec4, py       49     is8.     file*lec4, py       49     is8.     file*lec4, py       41     is8.     file*lec4, py       42     is8.     file*lec4, py       43     is8.     file*lec4, py       44     is8.     file*lec4, py       45     is8.     file*lec4, py  | 37               |  | Traceback (mos             | t recent call last):  |          |
| 39     cv2.imihov(*image with contour*, img);     cv2.veitkey(6)       40     feyboard.network     feyboard.network       41     cs = cv2.contourArea(contours[0])     c       42     cs = cv2.contourArea(contours[0])     feyboard.network       43     print(*fit; tif*(cs, cl));     feyboard.network       44     print(*fit; tif*(cs, cl));     feyboard.network       45     print(*fit; tif*(cs, cl));     feyboard.network       46     feyboard.network     feyboard.network       47     feyboard.network     feyboard.network       48     print(*fit; tif*(cs, cl));     feyboard.network       49     print(*fit; tif*(cs, cl));     feyboard.network       40     feyboard.network     feyboard.network   | 38               | cv2.drawContours[img, np.array[[selectedcontour]].0.             | f0 File "lec41.            | py", line 29, in <module></module>                              |          |
| implementer     impl   | 39               | cv2.imshow["image with contour", img]:                           | cv2.waitKe                 | ey(0)   |          |
| 41     C     C       42     Cs = cv2.voitoutiArea(contours[0])     (bise) [:Users/kdnin/Dropbox/hptel_codes/lec43/python lec41.py       43     print(*k1k kf*4(cs, cl));     (bise) [:Users/kdnin/Dropbox/hptel_codes/lec43/python lec41.py       44     print(*k1k kf*4(cs, cl));     (bise) [:Users/kdnin/Dropbox/hptel_codes/lec43/python lec41.py       45     print(*k1k kf*4(cs, cl));     (bise) [:Users/kdnin/Dropbox/hptel_codes/lec43/python lec41.py       46     print(*k1k kf*4(cs, cl));     (bise) [:Users/kdnin/Dropbox/hptel_codes/lec43/python lec41.py       47     (bise) [:Users/kdnin/Dropbox/hptel_codes/lec43/python lec41.py       48     print(*k1k kf*4(cs, cl));       49     (bise) [:Users/kdnin/Dropbox/hptel_codes/lec43/python lec41.py       49     print(*k1k kf*4(cs, cl));       40     (bise) [:Users/kdnin/Dropbox/hptel_codes/lec43/python lec41.py       41     print(*k1k kf*4(cs, cl));       42     print(*k1k kf*4(cs, cl));       43     (bise) [:Users/kdnin/Dropbox/hptel_codes/lec43/python lec41.py       44     print(*k1k kf*4(cs, cl));       45     (bise) [:Users/kdnin/Dropbox/hptel_codes/lec43/python/lec41.py       46     (bise) [:Users/kdnin/Dropbox/hptel_codes/lec43/python/lec41.py       47     (bise) [:Users/kdnin/Dropbox/hptel_codes/lec43/python/lec41.py       48     (bise) [:Users/kdnin/Dropbox/hptel_codes/lec43/python/lec41.py       49     (bise)   | 40               |  | KeyboardInterr             | upt   |          |
| cs = cv2.contourArea(contours[0])<br>c1 = cv2.acctapth(contours[0])<br>c1 = cv2.acctapth(contours[0]);<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKey(1)<br>cv2.waitKe   | 41               |  |                            |   |          |
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|  | LL LL            | ci = cv2.archength(contours[0], file)                            |                            |   |          |
|  | 77               | print(-si(t si-s(ca, ci));                                       |                            |   |          |
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So, this is needed in order to plot the contour which was originally converted to a list. So, this helps it to convert back to the data structure that the contour is the draw contour function requires ok. So, once this is done we should be able to plot the largest contour.

### (Refer Slide Time: 17:59)



So, let me run this everything seems to be going as per plan. Wow it is nice silky great alright. So, now, we are getting a bunch of outputs let us pipe that output to a data file. So, that later on you can plot it as well. So, in order to do that we will put it to out dot that. Let me stop plotting all this we do not need to plot once we a certain what needs to be done.

(Refer Slide Time: 18:56)



So, let me clear this file and let me re run it.

# (Refer Slide Time: 19:29)

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So, here we have all the areas and the perimeters ok. So, you can now load this file into python and plot it as well. So, with this in mind we have written a very easy problem. We have seen various concepts of blurring of isolation of mixing the channels finding out the edges finding out the contours ok.

The important thing is to smoothen out those edges otherwise then there will be small pockets of isolated contours which you do not want you want a nice single smooth contour. So, before concluding this lecture let me show you one more application of this for viscous fingering.

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So, this is a video discourtesy of Dr. Saurab Mandal of the chemical engineering department and student Pooja Singh she is a PhD student and so, in this experiment viscous fluid is being displaced by a less viscous fluid and the less viscous fluid in this case is water and it is colored pink.

So, as you can imagine the initial channel mixing has to be such that the pink has to be more prominent than the background. So, let us see I have already encoded it with a bit of trial and error, the green channel has been biased to -2.12 the blue channel has been biased to 0.245 and the red channel has been biased to 1.359.

So, with the help of this I am just showing the channel before isolation the mixed channel. So, I am just showing the mix channel for now ok.

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So, let me run this code ok. So, it takes a bit of time the video takes place after 6 seconds. So, you have to bear with me for with for this. So, let us let us just wait let us see what happens. So, as you can see the tube is quite prominent because the tube is carrying the liquid. Now once the liquid is being pushed you see that the front is nice and clear and once you threshold this it should be absolutely easy to find out the perimeter of the liquid ok.

The difficulty is this is and this is this has detached from the particular sample actually it will give you a bunch of contours. So, you have to loop over all contours to find out the perimeter I am not going to do that in this video, but maybe someone amongst you can do that anyway.

So, the point is once you find the appropriate bias of the channel, you can easily binarize the image. Now you can imagine how easy it will be to binarize this image because this is almost white everything is everything else is almost black ok. In addition to this because the tube is not moving you can sort of take the initial frame subtract the initial frame from all the frames to remove the tube, then you can sort of get a clear image of this fingering setup ok.

I am going to stop this over here. So, with this we end this particular lecture on image processing I know it is a bit power packed, but I have shown you all the important sort of

workflow there is to most of the image processing problems. And I really hope you will find all this very useful.

Special thanks to Shreyas Darshan professor Saurab Mandal and Pooja Singh for contributing to this particular video and the previous one as well. So, with this I take leave I will see you again next time bye.