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Question 1:

In the first question I had some problem between getting the circles from the white images and the yellow images, so I found that I can see if the image is yellow or not.

First I made a range for the yellow background color in the hsv image and I wrote a statement that says if the yellow pixels is 30% or more of the image then it a yellow image if not it a white image.

Steps of what I did:

- 1- I read the image and convert it to hsv
- 2- I saw if the image is white or yellow according to how much yellow there is in the image
- 3- If the image is yellow, I did this:
 - I combined the h_value and the s_value using this equation with the addWeighted function ($s_value * 1.5 + h_value * 0.2$)
 - Did a clahe and threshold to make the circles looks more clear
 - Did closing and opening to clear the photo from any object other that the circles
 - Did canny and found all the contours
 - For every contour find its perimeter to see if the contour is a good contour or has a 0 perimeter which says that the contour is some noisy pixels that doesn't have any meaning as a contour. Then find the best circle around the contour and see if I had a circle around this specific contour before because I had two contours in the same place. Finally save the x, y, radius and the color of this specific circle and save it in the result list I returned
- 4- If the image is white, I did this:
 - I combined the h_value and the s_value using this equation with the addWeighted function ($s_value * 0.8 + h_value * 0.2$)
 - Did a clahe and threshold to make the circles looks more clear with some noise around them
 - Did and opening to make the circles more clear
 - found all the contours for the opened image
 - For every contour find its perimeter to see if the contour is a good contour or has a 0 perimeter which says that the contour is some noisy pixels that doesn't have any meaning as a contour. Then find the best circle around the contour and see if the contour is a circle or not by finding its circularity, if the circularity is good then see if its a circle with a radius in range of (50, 130) and if the contour perimeter is close to the circle perimeter
 - If all these statements are right, then save the x, y, radius and the color of this specific circle and save it in the result list I returned

Question 2:

Steps of what I did:

- 1- For every image I got in the list I called the function of the first question and save the result it returned
- 2- For every circle in the result check if we saw this circle before or not doing this:
 - See all the circles we saved as a circle that we saw for the first time if we found a circle with the same color of the circle we have now do the next if
 - The second if is that I checked if the x and y of these two circles didn't change a lot then these are the same circles so we don't need to save this circle as a circle we see for the first time and take the pre-saved circle id for this circle
 - If not then this circle is a new circle that we didn't find in any image before so we give it a new circle id and save it in the list of the circles that we saw for the first time
- 3- Then after doing all of this for all the circles return to the first step and do all of this for every image and save all the circles in a list with these parameters (image id, circle id, x, y, radius, color)

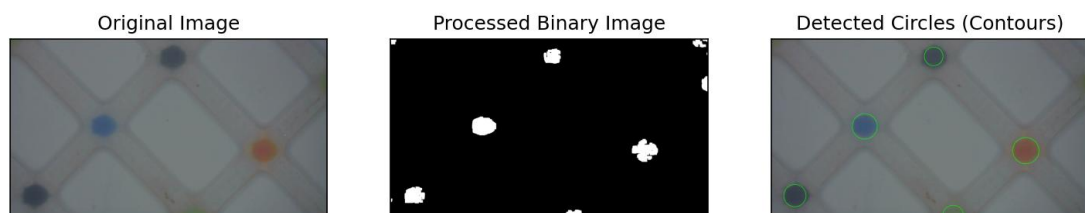
External functions:

- 1- `check_existense`: to see if the circle is found before or not (I used this for the contours of the yellow images)
- 2- `get_circle_color_in_yellow_image`: to find the colors of the circles in the yellow images doing this:
 - I found the difference between the green and blue, red and blue, red and green. With the differences I made some ranges for the three colors of the circles in the yellow images
- 3- `get_circle_color`: the same as before but for the white images

Note: I made two functions for the colors because the images with the yellow color have some different rgb values that the white images

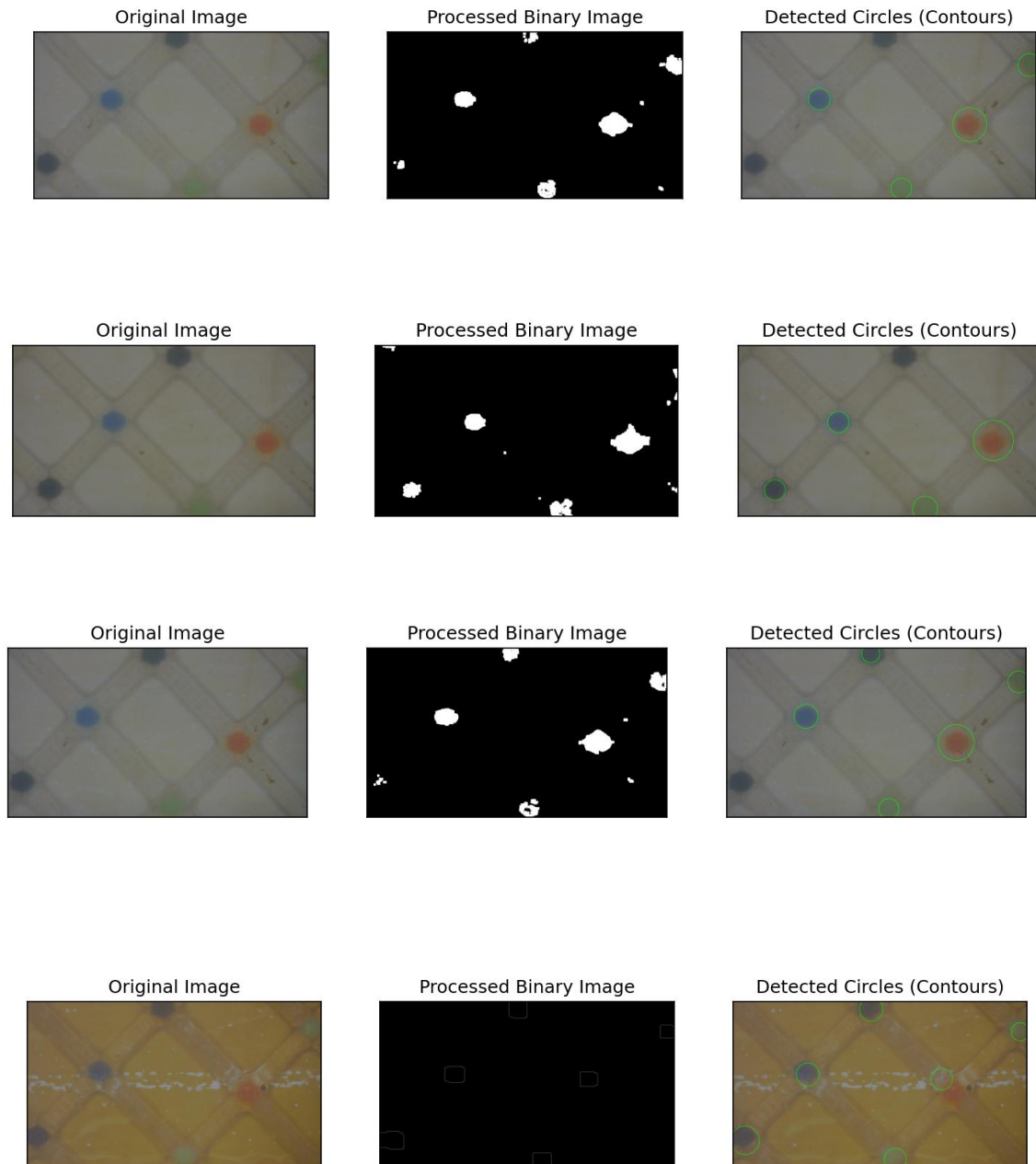
Results:

- 1- Random images results:



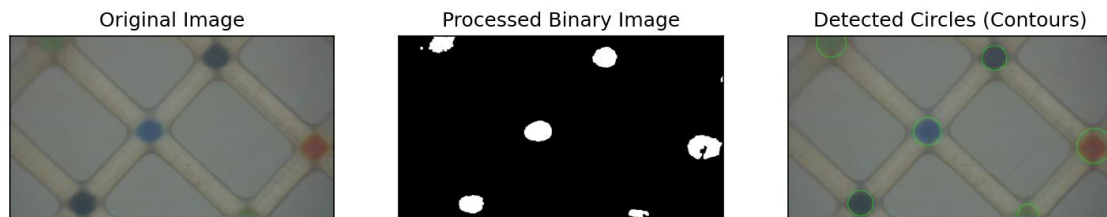
The result is:

```
PS C:\Users\malek\OneDrive\Documents\image processing\project> python .\final_project_im2025.py
[{'x': 1098.7249755859375, 'y': 1064.425048828125, 'radius': 63.973236083984375, 'color': 'green'}, {'x': 142.0, 'y': 943.9261474609375, 'radius': 67.84597778320312, 'color': 'blue'}, {'x': 1538.1954345703125, 'y': 672.5881958007812, 'radius': 79.51280212402344, 'color': 'red'}, {'x': 564.8616943359375, 'y': 526.5, 'radius': 76.1758041381836, 'color': 'blue'}, {'x': 981.0708618164062, 'y': 104.86437225341797, 'radius': 56.86970138549805, 'color': 'blue'}]
```



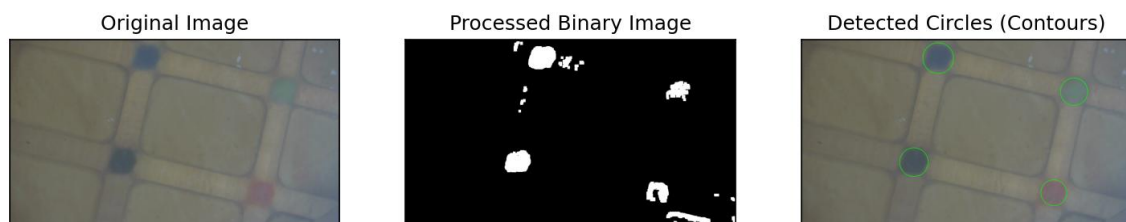
The result is:

```
[{'x': 1057.0, 'y': 1025.5, 'radius': 71.83497619628906, 'color': 'green'}, {'x': 78.5, 'y': 902.0, 'radius': 93.6123275756836, 'color': 'blue'}, {'x': 1360.5618896484375, 'y': 504.4998474121094, 'radius': 70.27919006347656, 'color': 'green'}, {'x': 487.0706787109375, 'y': 474.1507568359375, 'radius': 75.30811309814453, 'color': 'blue'}, {'x': 1872.5, 'y': 196.0, 'radius': 59.77676773071289, 'color': 'green'}, {'x': 900.0, 'y': 50.5, 'radius': 77.66122436523438, 'color': 'blue'}]
```



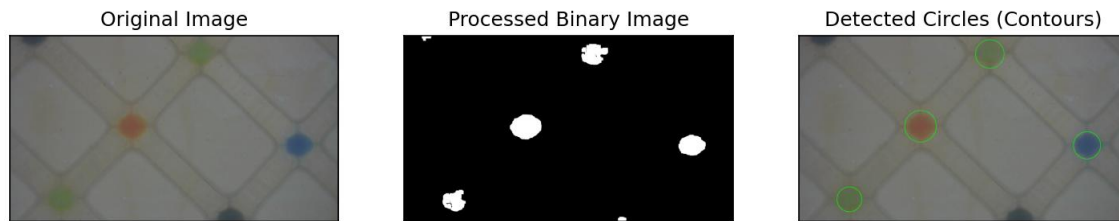
The result is:

```
[{'x': 110.5, 'y': 1038.5, 'radius': 57.900875091552734, 'color': 'blue'}, {'x': 1147.7388916015625, 'y': 1001.9837036132812, 'radius': 80.36566162109375, 'color': 'blue'}, {'x': 427.0, 'y': 703.5, 'radius': 62.588035583496094, 'color': 'blue'}, {'x': 41.5, 'y': 685.5, 'radius': 64.5949935913086, 'color': 'blue'}, {'x': 1170.0, 'y': 265.5, 'radius': 76.03462982177734, 'color': 'blue'}, {'x': 1908.197021484375, 'y': 225.0, 'radius': 50.17683029174805, 'color': 'blue'}]
```



The result is:

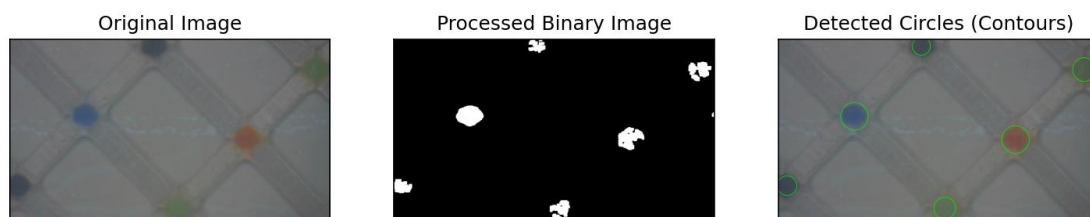
```
[{'x': 653.2996215820312, 'y': 709.5136108398438, 'radius': 83.35687255859375, 'color': 'blue'}, {'x': 1584.5, 'y': 301.0, 'radius': 79.7383138427734, 'color': 'blue'}, {'x': 794.2930908203125, 'y': 107.32976531982422, 'radius': 89.36780548095703, 'color': 'blue'}]
```



The result is:

```
[{'x': 294.0337219238281, 'y': 951.6127319335938, 'radius': 72.57316589355469, 'color': 'green'}, {'x': 1680.0, 'y': 637.0, 'radius': 79.83116912841797, 'color': 'blue'}, {'x': 709.5045776367188, 'y': 526.1343383789062, 'radius': 92.86988067626953, 'color': 'red'}, {'x': 1113.354736328125, 'y': 106.69401550292969, 'radius': 83.22197723388672, 'color': 'green'}]
PS C:\Users\malek\OneDrive\Documents\image_processing\project>
```

2- Results of sequence_1:



This is one of the images in the sequence

The final result of all the images together:

```
[{'image': 1, 'circle_id': 1, 'x': 1000.9559936523438, 'y': 971.2150268554688, 'radius': 69.22477722167969, 'color': 'green'}, {'image': 1, 'circle_id': 2, 'x': 50.75675582885742, 'y': 835.0, 'radius': 69.17559051513672, 'color': 'blue'}, {'image': 1, 'circle_id': 3, 'x': 1433.0, 'y': 556.5, 'radius': 72.5000991821289, 'color': 'red'}, {'image': 1, 'circle_id': 4, 'x': 458.5663146972656, 'y': 416.9744873046875, 'radius': 87.25930786132812, 'color': 'blue'}, {'image': 1, 'circle_id': 5, 'x': 1844.5, 'y': 136.5, 'radius': 62.6778450012207, 'color': 'green'}, {'image': 2, 'circle_id': 1, 'x': 1000.5, 'y': 1012.5, 'radius': 77.6306381225586, 'color': 'green'}, {'image': 2, 'circle_id': 2, 'x': 48.74324417114258, 'y': 880.5, 'radius': 64.66967010498047, 'color': 'blue'}, {'image': 2, 'circle_id': 3, 'x': 1421.01904296875, 'y': 604.7145385742188, 'radius': 82.7595443725586, 'color': 'red'}, {'image': 2, 'circle_id': 4, 'x': 451.5, 'y': 460.0, 'radius': 82.23908233642578, 'color': 'blue'}, {'image': 2, 'circle_id': 5, 'x': 1830.7352294921875, 'y': 177.69935607910156, 'radius': 67.6661376953125, 'color': 'green'}, {'image': 2, 'circle_id': 6, 'x': 856.525146484375, 'y': 45.41006088256836, 'radius': 61.06330108642578, 'color': 'blue'}, {'image': 3, 'circle_id': 1, 'x': 995.9051513671875, 'y': 1007.5435180664062, 'radius': 65.85256958007812, 'color': 'green'}, {'image': 3, 'circle_id': 2, 'x': 52.38214111328125, 'y': 873.6268310546875, 'radius': 58.02189254760742, 'color': 'blue'}, {'image': 3, 'circle_id': 3, 'x': 1419.64233984375, 'y': 598.8294067382812, 'radius': 82.04583740234375, 'color': 'red'}, {'image': 3, 'circle_id': 4, 'x': 454.5, 'y': 459.5, 'radius': 82.8403091430664, 'color': 'blue'}, {'image': 3, 'circle_id': 5, 'x': 1832.261962890625, 'y': 180.37673950195312, 'radius': 71.98539733886719, 'color': 'green'}, {'image': 3, 'circle_id': 6, 'x': 855.9132080078125, 'y': 40.74365234375, 'radius': 54.250946044921875, 'color': 'blue'}, {'image': 4, 'circle_id': 1, 'x': 993.17724609375, 'y': 1008.6793212890625, 'radius': 71.8849105834961, 'color': 'green'}, {'image': 4, 'circle_id': 3, 'x': 1415.5, 'y': 600.0, 'radius': 86.75982666015625, 'color': 'red'}, {'image': 4, 'circle_id': 4, 'x': 456.5, 'y': 460.0, 'radius': 79.19921875, 'color': 'blue'}, {'image': 4, 'circle_id': 5, 'x': 1829.5, 'y': 182.5, 'radius': 80.77447509765625, 'color': 'green'}, {'image': 5, 'circle_id': 1, 'x': 1005.0, 'y': 1014.0, 'radius': 70.93669128417969, 'color': 'green'}, {'image': 5, 'circle_id': 3, 'x': 1423.717041015625, 'y': 601.1676025390625, 'radius': 98.05916595458984, 'color': 'red'}, {'image': 5, 'circle_id': 4, 'x': 457.0, 'y': 457.0, 'radius': 75.31278228759766, 'color': 'blue'}, {'image': 5, 'circle_id': 5, 'x': 1825.7454833984375, 'y': 176.84814453125, 'radius': 84.0, 'color': 'green'}]
```

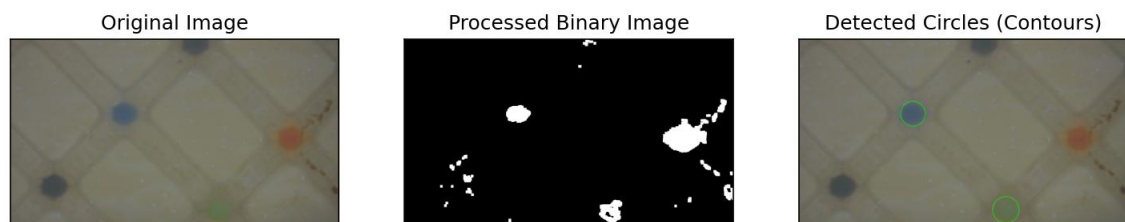


```

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C:\Users\malek\OneDrive\Documents\image_processing\project\

```

3- Results of sequence_2:



This is one of the images in the sequence

The final result of all the images together:

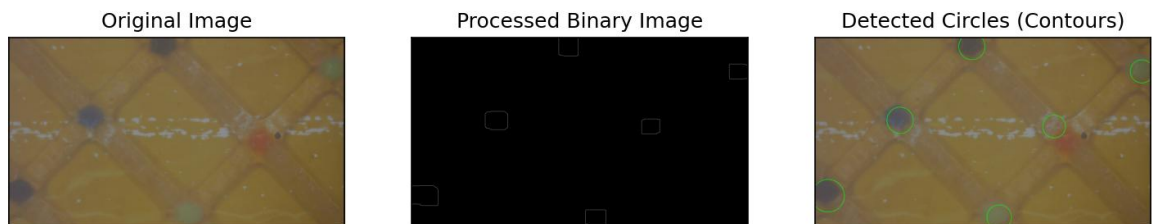
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PS C:\Users\malek\OneDrive\Documents\image processing\project>
```

4- Results of sequence_3:



This is one of the images in the sequence

The final result of all the images together:

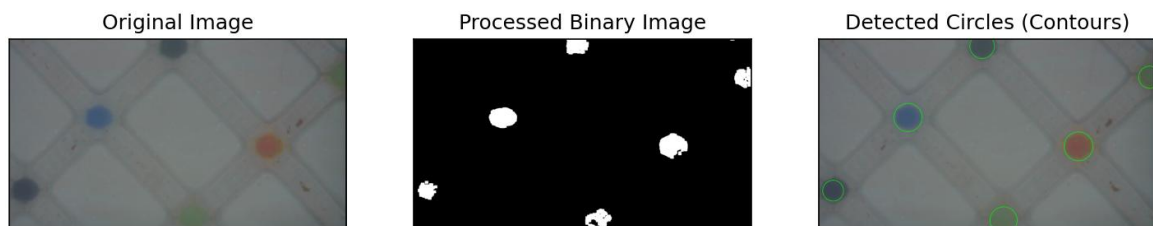
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5- Results for sequence_4:



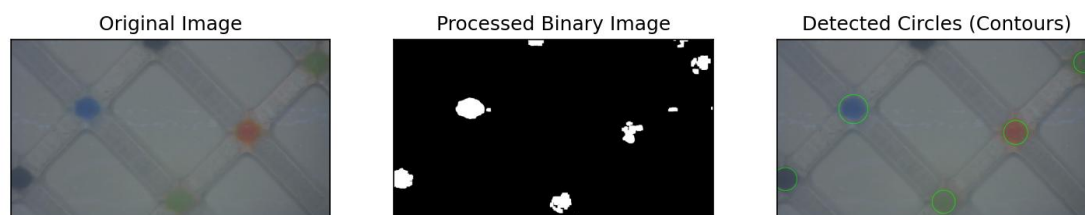
This is one of the images in the sequence

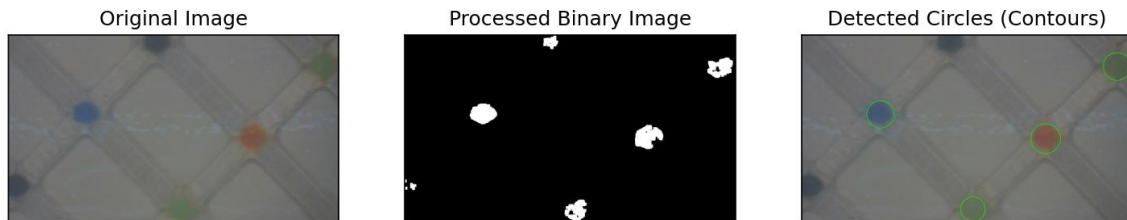
The final result of all the images together:


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- 6- Clear results of the second question:
The images:





The result of all these circles:

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[{'image': 1, 'circle_id': 1, 'x': 1000.9559936523438, 'y': 971.2150268554688, 'radius': 69.22477722167969, 'color': 'green'}, {'image': 1, 'circle_id': 2, 'x': 50.75675582885742, 'y': 835.0, 'radius': 69.17559051513672, 'color': 'blue'}, {'image': 1, 'circle_id': 3, 'x': 1433.0, 'y': 556.5, 'radius': 72.5000991821289, 'color': 'red'}, {'image': 1, 'circle_id': 4, 'x': 458.5663146972656, 'y': 416.9744873046875, 'radius': 87.25930786132812, 'color': 'blue'}, {'image': 1, 'circle_id': 5, 'x': 1844.5, 'y': 136.5, 'radius': 62.6778450012207, 'color': 'green'}, {'image': 2, 'circle_id': 1, 'x': 993.17724609375, 'y': 1008.6793212890625, 'radius': 71.8849105834961, 'color': 'green'}, {'image': 2, 'circle_id': 3, 'x': 1415.5, 'y': 600.0, 'radius': 86.75982666015625, 'color': 'red'}, {'image': 2, 'circle_id': 4, 'x': 456.5, 'y': 460.5, 'radius': 79.19921875, 'color': 'blue'}, {'image': 2, 'circle_id': 5, 'x': 1829.5, 'y': 182.5, 'radius': 80.77447509765625, 'color': 'green'}]
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