

# ***Optical Mark Recognition***

*June 22, 2021*

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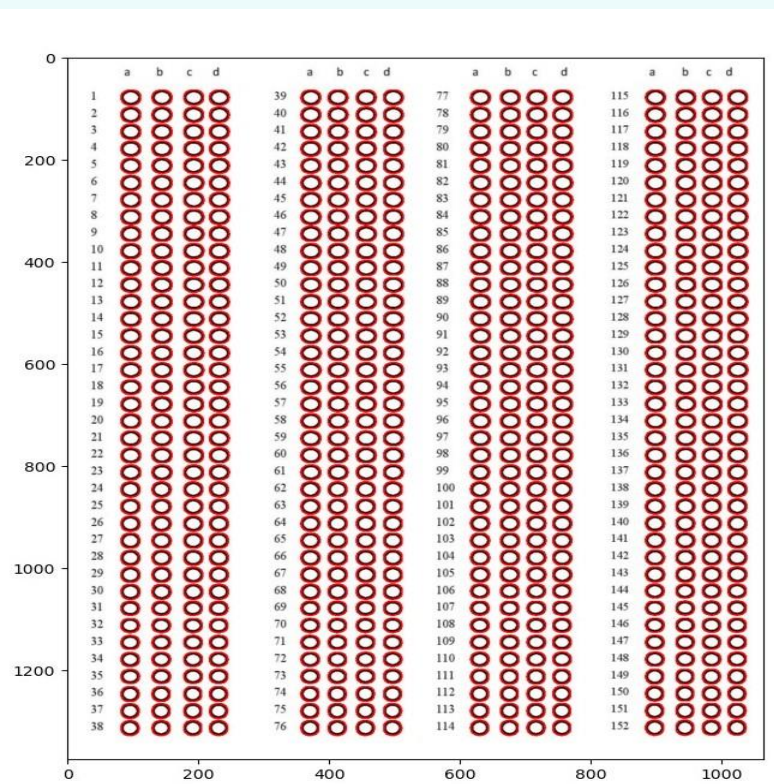
- *Grabbing and sorting the contours*
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# Grabbing and sorting the contours:

*In this section we are interested in the contours in our questions table but sorted this time. So, we grab them first then we sort them and store them in a variable.*

## Filtering only circles:

*Now that is a very critical step as its parameters are so sensitive and need a careful tuning. There is a trick implemented to overcome this problem in the 150 questions model, and we will discuss its details later.*

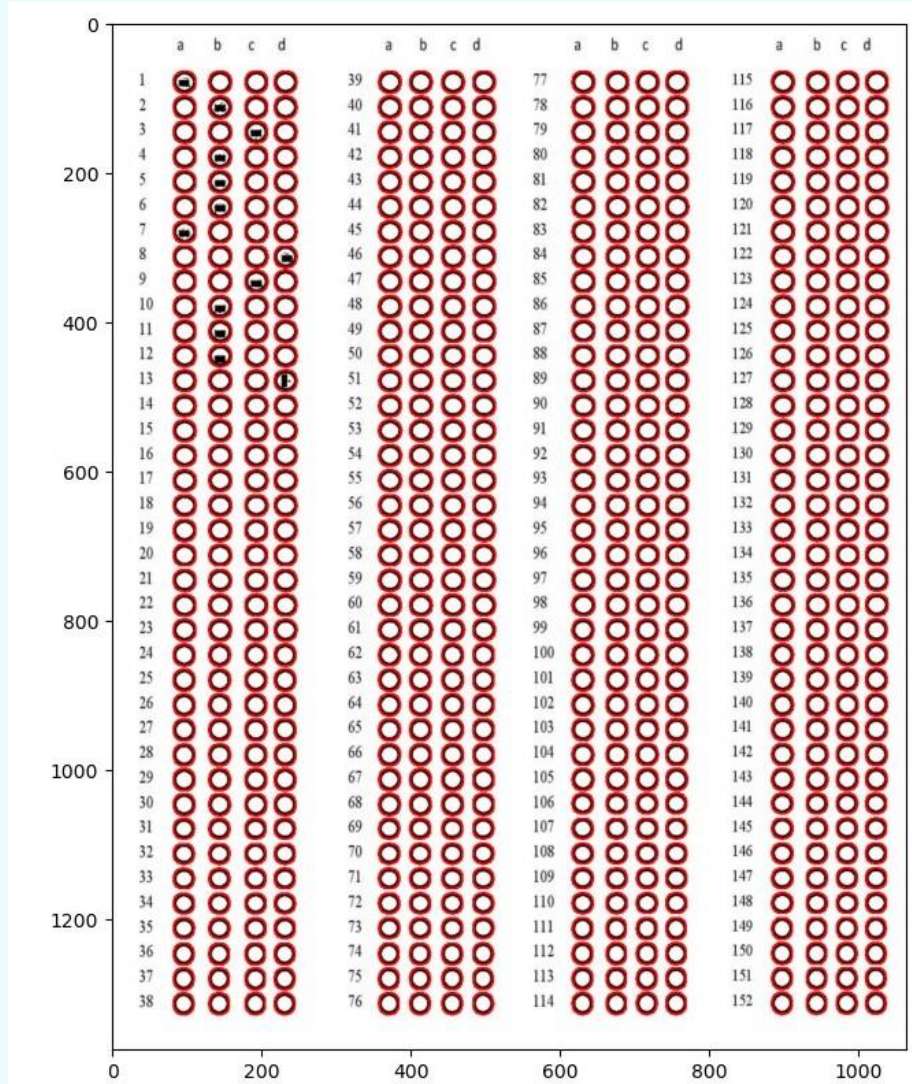


*Fig 1 Circles contours*

*Magic done! We finally reached a goal, we successfully and perfectly captured our 608 circles for our 152 questions. Note that when we say circles, we don't really mean circles, it's more of an oval, which is a good time to answer the question "why don't we just use circle detection? ". The algorithms available for circle detection need almost perfect circles which makes it nearly impossible usable for our task.*

## **threshold and making bubbles:**

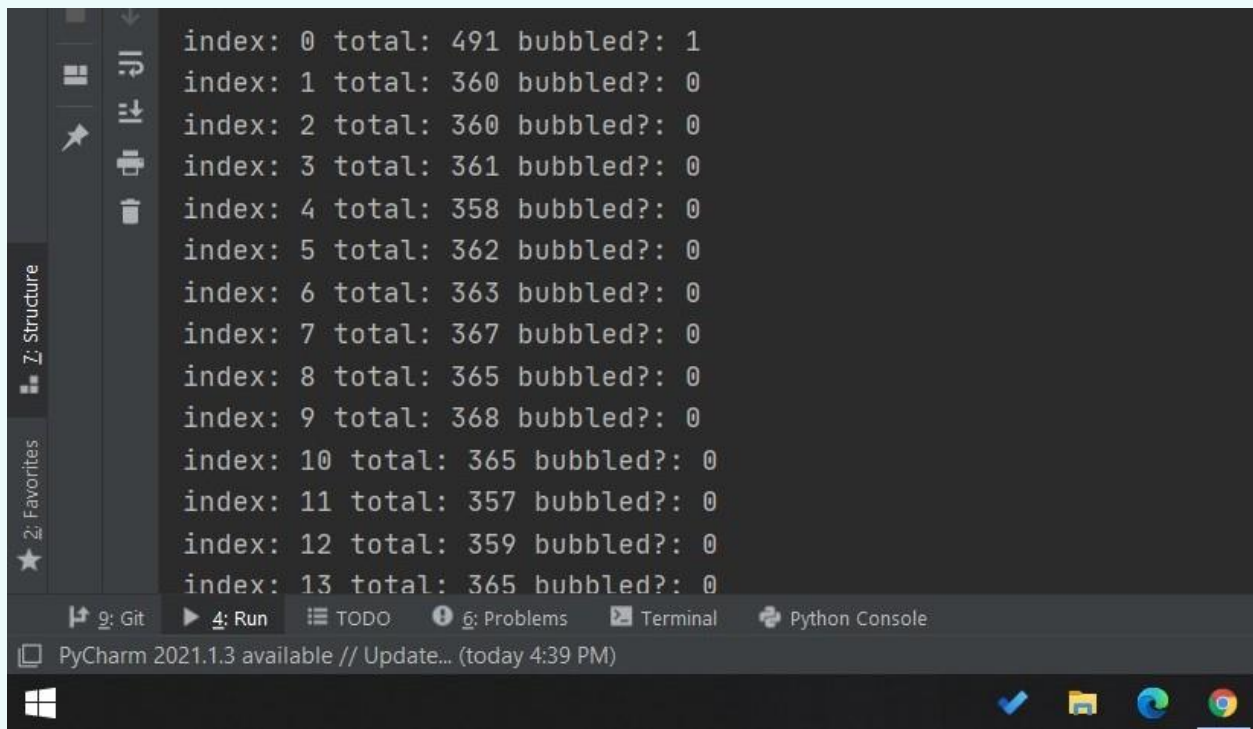
*Now got our contours or ovals detected and sorted, we need to know which one is answered and which is not. We can do this by applying threshold first and then counting the non-zero pixels inside of each oval. The more the oval gets a value, the more likely this oval is the answer for this question. This step also holds an important hyperparameter to tune. The figures below show an example.*



*Fig 2 bubbled questions*

*Well it's a little distorted filling to the circles but it will deliver the idea. The bubbled oval now has a bigger value than the non-bubbled ones.*





```
index: 0 total: 491 bubbled?: 1
index: 1 total: 360 bubbled?: 0
index: 2 total: 360 bubbled?: 0
index: 3 total: 361 bubbled?: 0
index: 4 total: 358 bubbled?: 0
index: 5 total: 362 bubbled?: 0
index: 6 total: 363 bubbled?: 0
index: 7 total: 367 bubbled?: 0
index: 8 total: 365 bubbled?: 0
index: 9 total: 368 bubbled?: 0
index: 10 total: 365 bubbled?: 0
index: 11 total: 357 bubbled?: 0
index: 12 total: 359 bubbled?: 0
index: 13 total: 365 bubbled?: 0
```

The screenshot shows the PyCharm IDE interface. On the left, there is a sidebar with 'Structure' and 'Favorites' tabs. The main editor area displays a list of 14 indices, each with a 'total' value and a 'bubbled?' status. The first index (0) has a total of 491 and is bubbled (1), while all other indices have totals between 357 and 368 and are not bubbled (0). At the bottom, there is a toolbar with icons for Git, Run, TODO, Problems, Terminal, and Python Console. A status bar at the very bottom indicates 'PyCharm 2021.1.3 available // Update... (today 4:39 PM)'.

index	total	bubbled?
0	491	1
1	360	0
2	360	0
3	361	0
4	358	0
5	362	0
6	363	0
7	367	0
8	365	0
9	368	0
10	365	0
11	357	0
12	359	0
13	365	0

*Fig 3 bubbled or not results.*

*In the figure above in the very first index we have the value 1, which indicates that there is a bubble in this place, which matches the figure 2.13.*

*There is an even better way to view the answers as if you are looking directly to the paper. Doing some logic with code, we can get this result in the figure below.*



# Renaming files with student name and grade:

*Now that we corrected all our sheets, we can rename the sheet with the name of the student and the student grade as the new file name. In the figure below there is an example.*

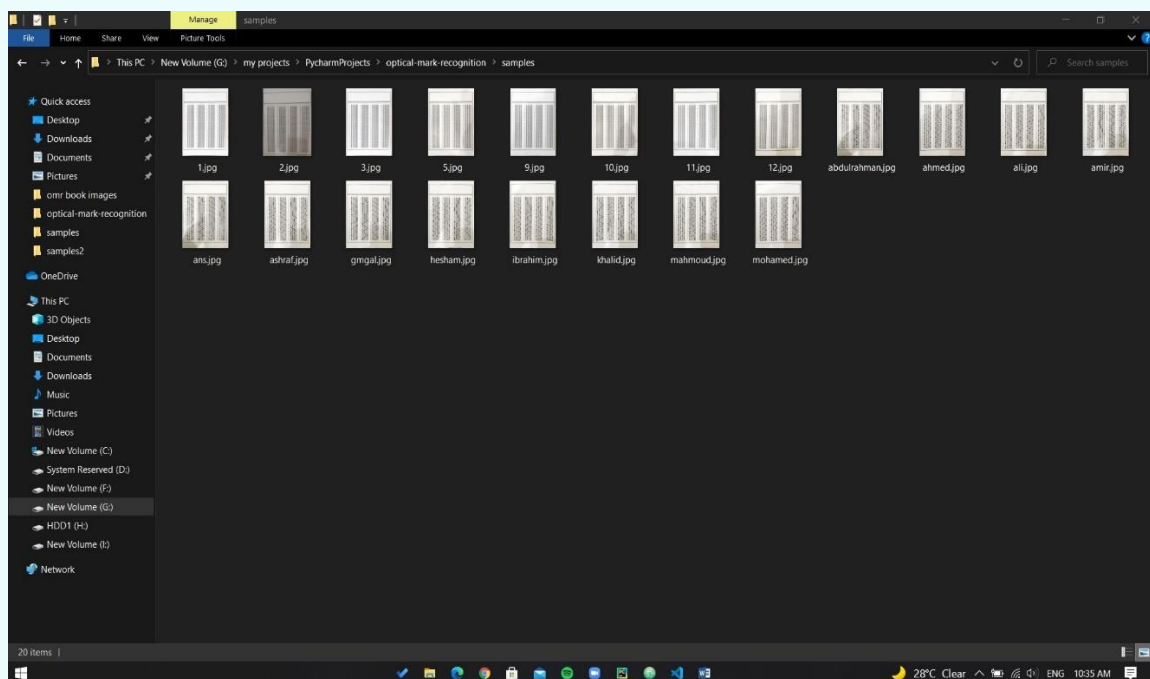


Fig 5 samples on project directory



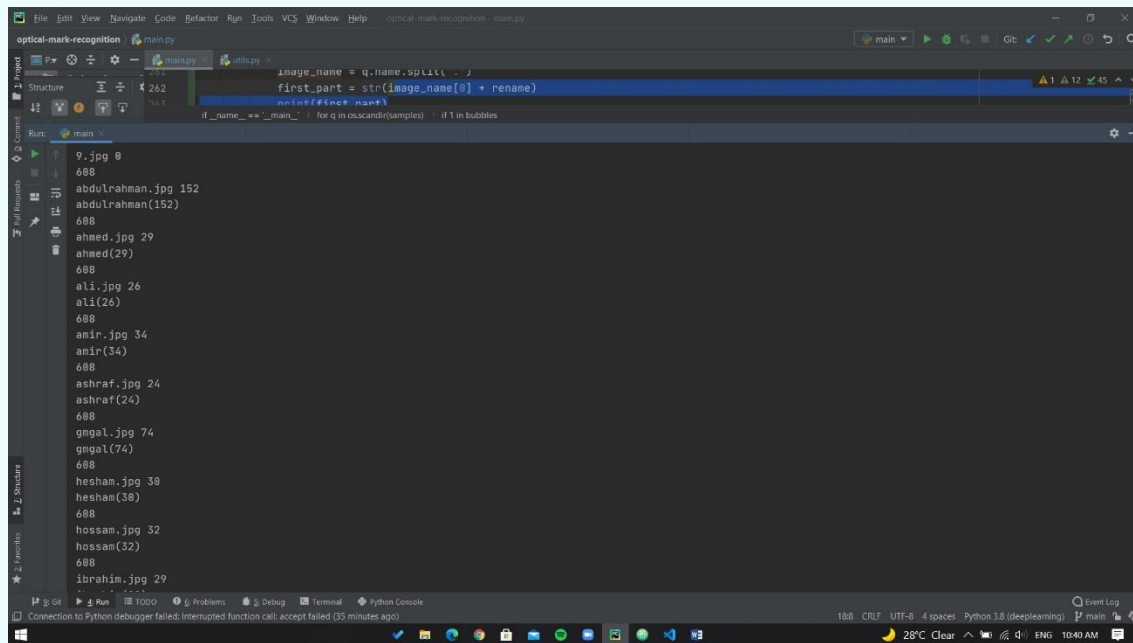


Fig 6 System Output

*While system is generating its output, it's also renaming each sheet and saving it in the project directory as in the figure below.*

abduLrahman(152).j...	7/7/2021 7:38 PM	JPG File	162 KB
ahmed(29).jpg	7/9/2021 9:12 AM	JPG File	157 KB
ali(26).jpg	7/9/2021 9:13 AM	JPG File	164 KB
amir(34).jpg	7/9/2021 9:13 AM	JPG File	162 KB
ashraf(24).jpg	7/9/2021 9:13 AM	JPG File	159 KB
gmgal(74).jpg	7/9/2021 9:13 AM	JPG File	159 KB
hesham(30).jpg	7/9/2021 9:13 AM	JPG File	159 KB
hossam(32).jpg	7/9/2021 9:14 AM	JPG File	162 KB
ibrahim(29).jpg	7/9/2021 9:12 AM	JPG File	162 KB
khalid(25).jpg	7/9/2021 9:13 AM	JPG File	158 KB

Fig 7 Files Renamed