Machine learning-based method to identify coverslips on microscopy slides

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Motivation

• Science researchers in the lab commonly conduct experiments in coverslips in microscopy slides. Information about those experiments is usually written in a notebook.

• Therefore, information retrieval and tracking from notebooks grows harder as more experiments are conducted.

• To help digitize the experiments we need to be able to detect the coverslips location & shape in images.

• This poses a unique challange, since, both the slide and the coverslip are transparent, and the images are taken using traditional smarphone cameras. Mainstream edge detection algorithms like Canny edge detection seems to perform quite poorly in this task.

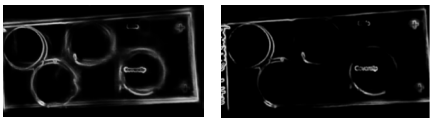
Sample Input Image

System Components

Edge Detection

The deep-learning based edge detection algorithm HED (Holesitic Edge Detection) tries to detect features initally before finding edges. HED was performing poorly in this inital phase, causing the poor performance in edge finding. We found out that the inital bluring step of HED is taking away valuable information needed in the feature detection phase.

Edge Detection (using modified HED)



Removing blurring | ***With blurring***

Deblurring improves HED algorithm for detecting coverslips

Coverslips Location Prediciton

HED output represent noisy grayscale imperfect images. Therefore, finding the accurate location of coverslips becomes a non-straightforward task. We tried using the Hough Circle Transform (CHT) to find the center of the coverslips, using a single accumulator resolution value over all pictures.

This method accurately predicated the location of coverslips only at a small subset of the images. We incorporated a heuristic based on the dimensions of a standard microscope slide in the CHT, and, run the modified CHT algorithm using a range of accumlator resolutions then approximate the optimal answer based on the mentioned heuristic.

Location Prediciton (using Hough Circle Transform)

without heuristic | ***with heuristic***

Adding the heurstic, based on standard microscopy slide dimensions, increasing location prediction significantly using CHT algorithm

Conclusion

We achieved higher than 90% accuracy on a range of mid to low resolution images with less than 3 secs runtime performance on 2.8 GHz Dual-Core Intel Core i5. In parallel, with this project, we developed a iOS application to track information about experiments as an alternative to recording information in note books. This project can be used with the app for a auto detection of coverslips which can ease the information recording and retrieval process considerably.

References

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