Digital Video Processing

Term project

GRABCUT Implementation

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Overview

GrabCut is an interactive segmentation method. Which allows the user to determine the Region of interest (to be extracted as the foreground). GrabCut perform segmentation of objects as foreground and background by reducing an energy function. The minimisation of the energy function is done by Mincut - Maxflow algorithm. Grabcut algorithm can be considered to be as a two class classification problem.

GrabCut performs segmentation on the intensity values. By specifying the Region of Interest (ROI) the user provides the in general colour distribution of the foreground region and the image excluding the ROI is used to determine the colour distribution of background region.

To implement Mincut - Maxflow algorithm, we need to determine the dataterm and interaction term between the neighboring nodes. The values of the dateterm are determined from the Gaussian Mixture Models (GMM) which are used to learn the colour distribution. There are two GMMs used, one for the foreground and other for the background. Using GMM we determine each node being foreground object or background object. The dataterm is logarithmic value of the probability predicted by the GMMs for the particular pixel node.

Interaction term is calculated between neighboring pixel nodes. The interaction term is determined by the Manhobalis distance between the colour values of the pixels. If the colour pixel values of neighboring nodes are different than the interactive term value will be large.

Method implementation

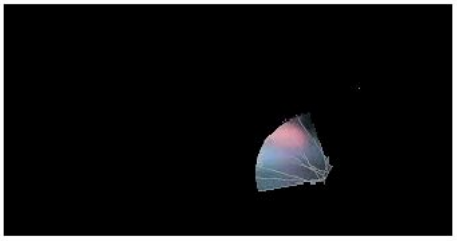
1. We implemented the our version of GrabCut and also the GrabCut implementation available in the OpenCv platform.
2. To implement Mincut - Maxflow algorithm we used the available Python library PyMaxflow. Which has the implemented version of the Boyokov and kolomogrov algorithm.
3. We used OpenCV to extract ROI.
4. The method implemented is iterative. The stopping criteria is not defined. We run the method for a certain iterations and pick the best segmented image in relation to the segmented image from OpenCV method.

Results

First row left column is the selected image the first row right column is the GrabCut implementation from OpenCV. The rest other images are extracted from our grabcut implementation.

Observation:

The image selected has bokeh effect. The foreground object is focussed and the rest of the blurred image is to be considered as background. The foreground and the background objects can be recognized easily as the distributions followed are very different which leads to better extraction of the region.


Left figure is the image selected. Center image is the image extracted with OpenCV implementation. Right image is extracted from our implementation.

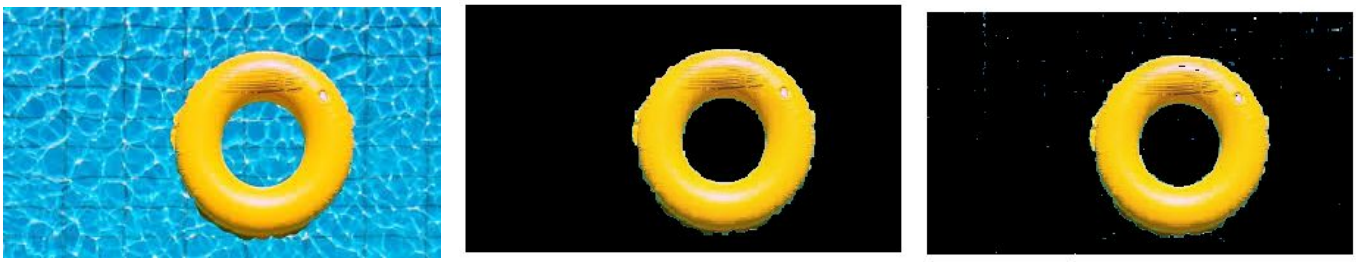
Observation:

GrabCut fails here as the colour distribution for the foreground (cycle) and the background is closely similar.


Left figure is the image selected. Center image is the image extracted with OpenCV implementation. Right image is extracted from our implementation.

Observation:

The colour distribution of the foreground and background are very different. The foreground objects have red, blue and white mostly and the background is completely determined by green. The grabcut algorithm extracts foreground objects effectively.



Left figure is the image selected. Center image is the image extracted with OpenCV implementation. Right image is extracted from our implementation.

Observation:

The colour distribution of the foreground and background are very different. There are only two different colours present in the picture. The GMMs can accurately learn the colour distribution.

Inferences:

1. GrabCut uses intensity values for segmentation.
2. If the foreground and background object have different colour distribution GrabCut algorithm extracts region effectively.
3. If there is significant overlap of colour intensity values then the method might fail in extracting the foreground region.
4. The model does not consider relation between the foreground objects.

References

1. **ROTHER, C., KOLMOGOROV, V., AND BLAKE, A. 2004. Grabcut - interactive foreground extraction using iterated graph cuts. Proc. ACM Siggraph.**
2. **https://pdfs.semanticscholar.org/9246/cbf8d7a489b2c6299317416c7dfdf747f72b.pdf**
3. **http://pmneila.github.io/PyMaxflow/**