Hough transform approach

# Outlines of the method

# Advantages & Disadvantages

## Advantages

Fast

Easy implementation

## Disadvantages

Does not cope well with non-frontal irises (eye become elliptical instead of circle)

# Discussions of implementation

## Eye detection using Viola-Jones algorithm

The trained Haar classifier included in OpenCV allows for quick and easy detection of eyes. It works well under our indoor lighting video sequences. However, using it directly will include the eye-brows. One can employ a heuristic approach: removing the top 40% of the detected region in order to remove the eye brows. This approach works well for our video sequences. We did not experiment with re-training of the Haar classifier for only the eye. However, we hypothesize that eye-brow information is useful in detection of the eye. Thus, using an eye detection which are trained with eyes including eye-brows then removing the eye-brow section should be a preferred approach.

## Choosing the right parameters for Hough transform

## Using original images without thresholding

Requires quite a bit of parameter tuning which suggests that the approach is not robust to different images and settings.

## Using thresholding with Otsu theshold (targeting skin segmentation)

Otsu thresholding is

Otsu thresholding removes the requirement of picking the right parameter for the binary threshold. However, it doesn't work well with skin under arbitrary lighting.

|  |  |  |
| --- | --- | --- |
|  | Good case | Bad case |
| Thresholded image with Otsu | D:\dc\Dropbox\My Dropbox\Courses\DIP\uhiris\ForReport\Skin segmentation\input_12.png | D:\dc\Dropbox\My Dropbox\Courses\DIP\uhiris\ForReport\Skin segmentation\input_1.png |
| Edge map of thresholded image | D:\dc\Dropbox\My Dropbox\Courses\DIP\uhiris\ForReport\Skin segmentation\edge_12.png | D:\dc\Dropbox\My Dropbox\Courses\DIP\uhiris\ForReport\Skin segmentation\edge_1.png |
| Found Hough circle | D:\dc\Dropbox\My Dropbox\Courses\DIP\uhiris\ForReport\Skin segmentation\iris_12.png | D:\dc\Dropbox\My Dropbox\Courses\DIP\uhiris\ForReport\Skin segmentation\iris_1.png |

One can see that bad results from thresholding using Otsu (i.e. including regions outside of the eye), do not mean the end result will be bad.

## Using really high quality image

Using a very high quality image, we get a rather interesting (but bad) output (figure 1). Using a high quality mode in our Logitech Quickcam Orbit AF, we can get a really high resolution of the eye. In the image on the right, the user holds the camera as close to the eye as possible and still get the eye in focused. This creates a problem since the iris will reflect the scene in front of the subject. Such reflection is then detected by Viola-Jones detection algorithm. The algorithm will then give a bad region detection.

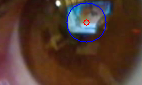


Figure : Eye detection get confused by reflection in the iris

# Future works

## Handling non-frontal irises

Using the average iris for human, then perform matching while considering iris as a patch lying on a perfect sphere.

### Handling higher quality images

We can use the information reflected from the iris for other purposes. (quote that paper) One can use artificial light in order to get information (i.e. artificial known lighting arrangements). Then we can use this information to detect the gaze of the user assuming that the light fixture does not move in space.