Artificial Vision and Pattern Recognition

Lab Assignment 1

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1 Introduction

I have collected all the material related to this laboratory, code, paper and report on a Github repo, available at jeorjebot/automatic_nipple_detection.

2 Implementation of the Algorithm

2.1 Algorithm phases

As described in the paper [1], I divided the entire process in three phases:

1. **Human Body Segmentation phase**, that take as input the termograms images, locate the body and provide as output the images of the human body with a masked black background (closed and dilated).
2. **Adaptive Threshold phase**, that take as input the images of the previous phase, calculate a threashold for each pixel with the adaptive threashold algorithm and provide as output the thresholded image.
3. **Nipple Selection phase**, that analyze the output of the previous phase, exclude upper, lower regions and objects that lies on this division, locate the nipples candidates and detect the nipples according to a list of features.

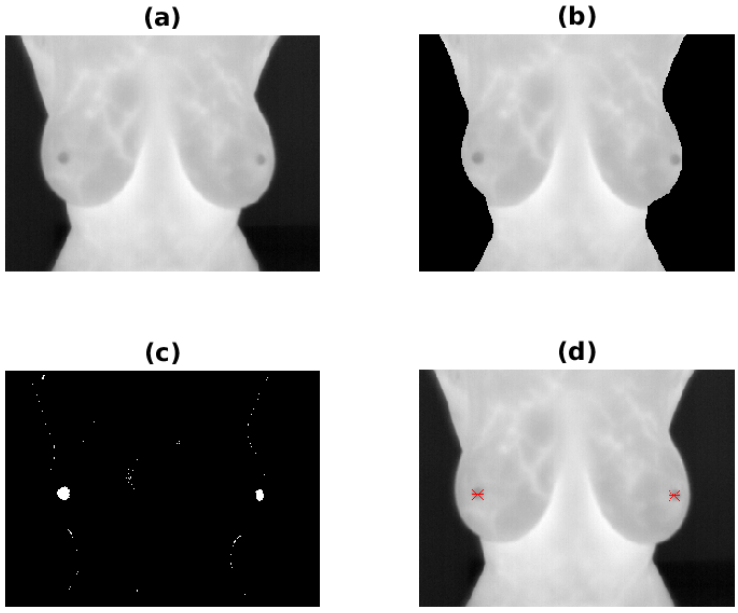

Figure 1: **(a)** the input image, **(b)** the segmented image, **(c)** the threasholded image, **(d)** the detected nipples

2.2 Algorithm implementation

I have implemented each of the three phases described before as a function, following methodically the informations provided by the paper. For each image, my algorithm perform all three phases, saving the intermediate output in a proper directory (segmented, filtered), an example is depicted in Figure 1.
The final result is saved in the **output** directory.

2.3 Results

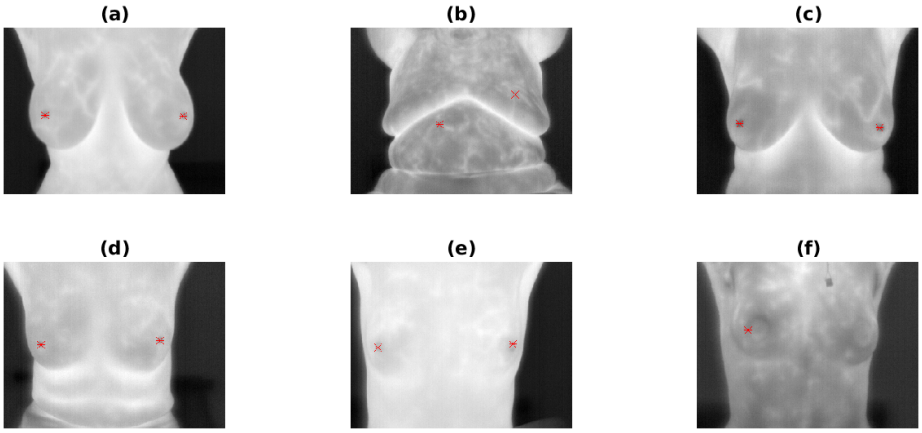

Figure 2: Nipple Selection phase output

The algorithm correctly detect nipples: as shown in Figure 2 in **(a)**, **(c)**, **(d)** and **(e)** images, the algorithm has identified a pair of round nipple, one in the left side and the other on the right side.

In the **(b)** image, the detection was incorrect, due to the fact that nipples are not clear or present in the images.
The **(f)** image was a particular case: here, where it is more difficult to locate a round nipple, the algorithm identify only a point on the nipple border.
I tried to change hyperparameters (in particular adaptive threshold hyperparameters such as neighborhood and C constant) but the result has not improved.

The execution time of the algorithm is limited by the performance of Matlab Online, which is a cloud provided service, but the execution time on my laptop is similar to the result achieved in the paper.

2.4 Tools

To implement the algporithm proposed in the paper, I choose to use Matlab Online and Live Script, a sort of Python Notebook provided by Matlab, where you can mix code, formatted text and images, and visualize better the output.

References

[1] Mohamed Abdel-Nasser et al. "Automatic nipple detection in breast thermograms". In: *Expert Systems with Applications* 64 (2016), pp. 365–374. ISSN: 0957-4174. DOI: https://doi.org/10.1016/j.eswa.2016.08.026. URL: http://www.sciencedirect.com/science/article/pii/S095741741630416X.