



Initial Report - Analysis of hepatic steatosis using fat cell segmentation

Team: defaultteam1

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1 Theme description

In the last few decades, the consumption of heavily processed foods has increased heavily, in the whole world. This has lead to an increased obesity rate in the majority of the population, which in turn leads to increased fat deposits on the organs. These fat deposits pose a great health risk, especially if they're found in certain vital organs.

If more than 5% of the total volume of the liver is made up of fat, the patient is diagnosed with hepatic steatosis, or fatty liver disease, in the absence of excess alcohol intake, viral infection, or drug treatments. If left untreated, the disease will worsen and lead to fibrosis and cirrhosis, which can be fatal. As such, it is of great importance to diagnose and treat hepatic steatosis early on to prevent these cases.

Up until recently, diagnosis has been done invasively, by taking a biopsy from the patient and having a practitioner look at the probes using a microscope, perform a statistical analysis and give a diagnosis. Since this method isn't very reliable, accurate and takes a long time, we propose an algorithm which performs processing on the biopsy images to detect the fat cells using edge detection and segmentation, carries a statistical analysis and give out a diagnosis.

While there are non-invasive methods available, such as using MRI or CT scans, the biopsy is still considered the golden-standard, as it provides the best accuracy. As such, we plan on developing an algorithm along with a GUI application for this method which will try to compare to already developed, professional tools used by medical staff daily.

2 Proposed work methodology

Identification and allocation of tasks

Task ID	Task description	Team member
task1	Initial prototype of preprocessing algorithms	m2
task2	Initial prototype of GUI app for task1 testing	m1
task3	Use GUI to determine preprocessing algorithm constants and document them	m1 & m2
task4	Initial prototype of edge detection to essentially segment fat cells	m2
task5	Using detected edges, detect the correct shape of fat cells	m1
task6	Integrate the prototypes in the GUI for further testing and fine tuning	m1
task7	Fine tune the preprocessing algorithms for the edge processing algorithms	m1 & m2
task8	Implement the statistics reporting in the GUI for a diagnosis	m1
task9	Document the fine tuned algorithms	m2
task10	Create the final article of the whole app	m1 & m2

Further detailing of tasks

Task1 - Develop some basic algorithms which will prepare the image for the detection algorithms e.g: grayscaling image, binarization, contrast enhancing, blurring, adaptive equalization, etc.

Task2 - Develop a GUI application that will display the result of the preprocessing algorithms. A special testing mode should allow to fine tune the constants used in the algorithms for easier testing.

Task3 - Using the GUI, the algorithms should be tuned to result a usable image for the next stage in processing.

Task4 - Develop an edge detection algorithm to detect the cells in the biopsy from the rest of the tissue.

Task5 - Develop a shape detection algorithm using the detected edges to detect circle-like shaped which represent the fat cells.

Task6 - Adapt the GUI to use the newly made algorithms and display the results. Eventually, the GUI in the testing mode should allow to reorder the processing steps and disable/enable them as needed, besides setting values and thresholds.

Task7 - Use the GUI to fine tune the constants used in the algorithms to achieve the best results in the shape detection.

Task8 - Calculate the total percentage of fat in the given images and display the statistics in the GUI.

Task9 - Document the final algorithms used in the GUI.

Task10 - Write-up the final article detailing the implementation.

Link to Git repository [here](#).

3 Referințe

[1] Nassir F, Rector RS, Hammoud GM, Ibdah JA. Pathogenesis and Prevention of Hepatic Steatosis. Gastroenterol Hepatol (N Y). 2015 Mar;11(3):167-75. PMID: 27099587; PMCID: PMC4836586.

[2] Wikipedia contributors, "Fatty liver disease," Wikipedia, Oct. 01, 2023. https://en.wikipedia.org/wiki/Fatty_liver_disease.

[3] J. Starekova, D. Hernando, P. J. Pickhardt, and S. B. Reeder, "Quantification of Liver Fat Content with CT and MRI: State of the Art," Radiology, vol. 301, no. 2, pp. 250–262, Nov. 2021, doi: 10.1148/radiol.2021204288.

[4] N. Batool, "Detection and Spatial Analysis of Hepatic Steatosis in Histopathology Images using Sparse Linear Models," Dec. 12, 2016. <https://inria.hal.science/hal-01419385>