CardioWave - Quantitative Analysis of IVC Dynamics: Detecting Anterior-Posterior Diameter and Respiratory-Induced Collapse

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Introduction

This application purpose is to detect anterior-posterior diameter and collapse with respiratory phases in IVC (Inferior Vena Cava).
Its use is going to reflect into emergency and training support in its initial phases. Then it can be further scaled for other use-cases as well.

Link to full app: https://github.com/ciprianturcu/CardioWave

1 Base flow

1.1 Functionalities

The user can upload a photo. The photo then goes through the AI, creates a raport that can completed by the user and saved.

1.2 Plastic and formal description of the resolved problem with AI

Our first complete path is made by:
Steps:
1. Pre-processing
1.1 Cropping for keepin the ROI
2. Image Segmentation
2.1 K-Means++
3. Object size measurement
3.1 Gray + GaussianBlur
3.2 Canny for edge detection
3.3 Hough lines for IVC specific lines detection

3.4 Compute the distance between two hough lines

Future improvements:
Add YOLO for 1.1
Optimize the specific lines detection

Result:
Lines on IVC with the dimension detection and printed dimension.

1.3 Related work and useful tools and technologies

Related work:
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7705480/

Useful tools:
- PyCharm

Tech stack:
- programming: python
- data processing: opencv, numpy, pandas, tkinter, PIL, sklearn

Dataset:
- simulated IVC images (received on 6-nov-2023)

1.4 19-nov-2023: Meeting with the doc notes:

Application Purpose:

What it Detects (more specifically):

The application is designed to detect specific medical conditions or features, such as the anterior-posterior diameter and collapse with respiratory phases in IVC (Inferior Vena Cava).

Users Besides Novice Doctors:

In addition to novice doctors, the application might be utilized by medical residents, for daily use, and as a training tool. It could also benefit medical students for educational purposes.

Additional Notes:

- **Daily Use and Education:** Focus on making the application user-friendly for daily use by novice doctors and effective for educational purposes, especially for training medical students.

- **Device Compatibility:** Consider the compatibility of the application with point-of-care devices, tablets, and medical simulators.
- **Educational Impact:** Assess how effectively the application aids in the education of students and how quickly they grasp medical concepts.
- **Comparison with Medical Professionals:** Explore how the diagnostic accuracy of the application compares with the expertise of experienced medical professionals.
- **Specifics in IVC Analysis:** Highlight specific features to look for in IVC analysis, such as the anterior-posterior diameter and variations during respiratory phases.

Efficiency Considerations:

- **Validation:** Prioritize a thorough validation process before using the application as a diagnostic measure.
- **Time Interval for Diagnosis:** The time interval for providing diagnostic results needs to be discussed, with considerations for balancing accuracy and speed (e.g., 5 minutes vs. 10/20 seconds).