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

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November 20, 2023

Introduction

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).

1 Base flow

1.1 Functionalities

The app will be able to upload or select an image.
Then the photo will be processed, filtered, contoured and after that, analysed by AI in order to determine the dimension, and collapse.

1.2 Plastic and formal description of the resolved problem with AI

For the first iteration, we are heading towards U-Net.

Steps:

1. Annotate data for U-Net (here are two ways, one of using K-Means or Waterhold, experimented both, K-Means with 4 clusters is the best)
2. Image crop, processing, editing and filtering
3. Image segmentation and contour (Unsupervised, maybe W-Net or something else and U-Net will be our algorithms)
4. Compute dimension
5. Compute maximum and minimum and decide for the collapse

Result:

Annotated image with the object.
The dimension values on the screen.
Collapse.

1.3 Related work and useful tools and technologies

Related work: - IVC analysis: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7705480/
- Object size detection: https://www.ijitee.org/wp-content/uploads/papers/v8i6s4/F10860486S419.pdf
Useful tools: PyCharm
Tech stack:
- programming: python
- data processing: tensorflow, keras, opencv, pytorch, possibly others too
Dataset:
- from the medics, received on 6-nov-2023

1.4 13-nov-2023: Meeting with our medic guide, Simon Robert

1.4.1 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).

1.4.2 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.

1.4.3 Display at the End:

The application proposes generating a report containing the diagnoses provided by both the human doctor and the AI, along with relevant patient and doctor data.

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.
- **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.

Implementation Details:

- **Image Storage:** For simulator images, cloud storage could be used, while images related to real patients could be stored locally with digital signatures.

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).