LIQUID VOLUME DETECTION FROM DRAIN IMAGES

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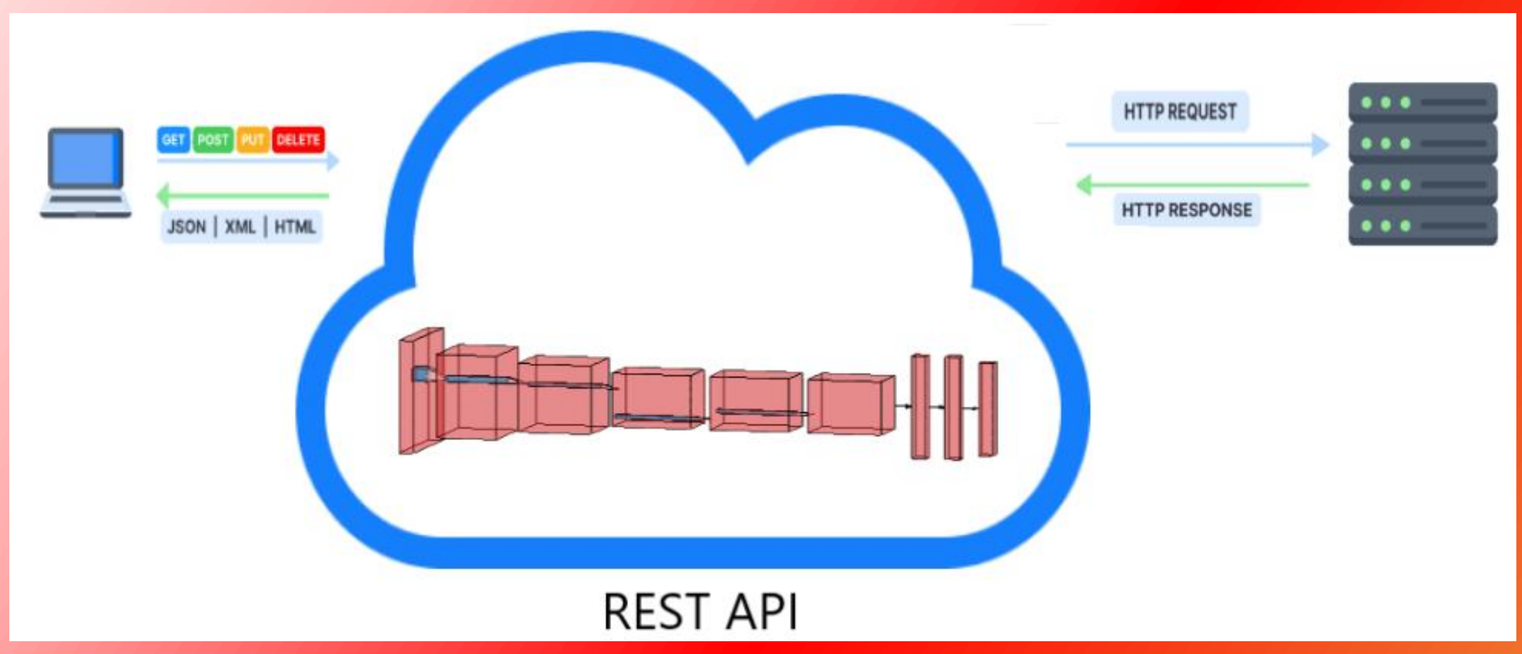
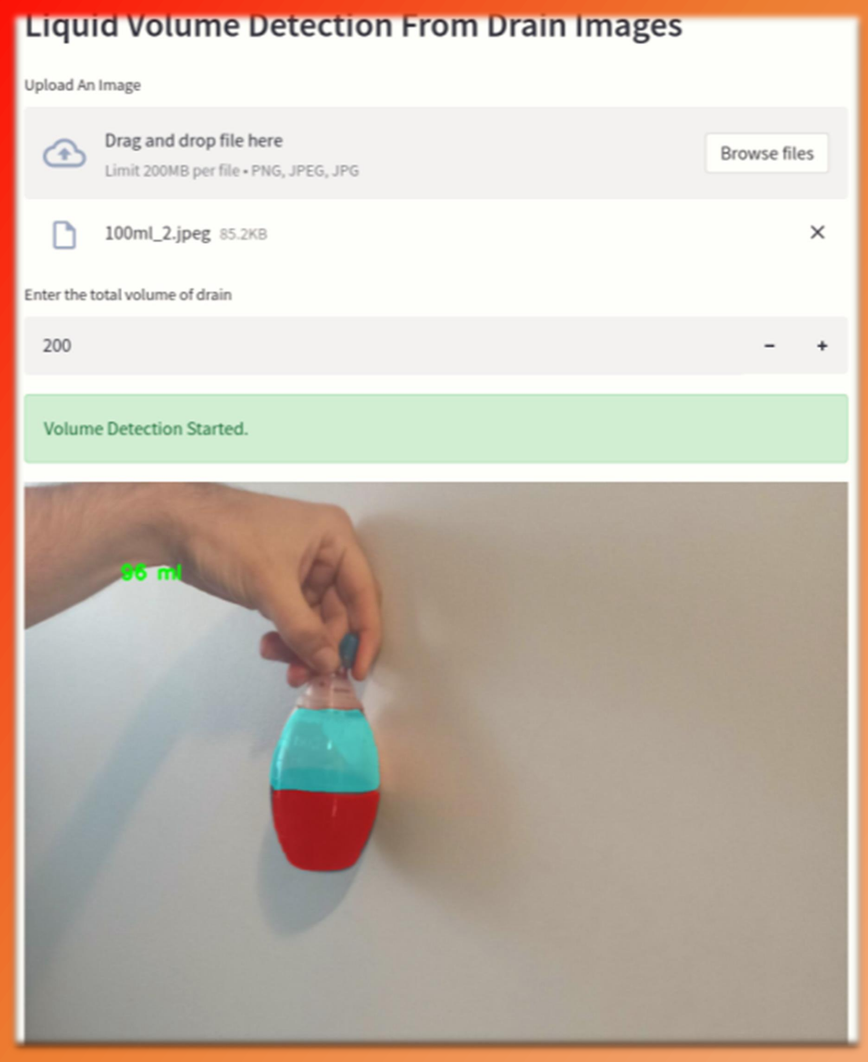
Introduction

This paper presents a solution for measure liquid in drains with deep learning algorithms. The work has been mainly focused on Mask R-CNN. Unlike other regional CNN models, Mask R-CNN gives detected objects masks.
Our algorithm tries to find most fitted masks for empty part and liquid part of drain. Software uses detected masks and total volume in milliliter to measure the blood volume. Providing to work independently from drain type, software takes total volume of drain from user. Results tested for various conditions and found results with %3 error rate.

Solution Methodology

- **Masked RCNN generates bounding boxes and segmentation masks for each instance of an object in the image. It's based on Feature Pyramid Network (FPN) and a ResNet101 backbone.**
- **Our model detect blood part and empty part separately in drain and gives masks of these detections. Total pixel sizes of these masks saved and sum of these saved as total_pixels_of_drain. The software takes total volume of drain ("total_volume_in_ml") as an input for calculate the blood volume in milliliter. blood_mask_pixels + empty_mask_pixels = total_pixels_of_drain blood_volume_in_ml = (blood_mask_pixels * total_volume_in_ml) / total_pixels_of_drain**
- **Streamlit is an open-source python framework for building web apps for Machine Learning and Data Science.Streamlit used for running our model on server so that patients can access our project easily everywhere**





Results and Discussion

Nowadays, deep learning and machine learning methods that we see so often, have not taken much place in the volume measurement of liquids. With this project, it is purposed to solve a daily problem for contributing the AI community. This problem is, after some surgery, measuring the edema fluid which comes out from the wounds that is intentional open wound is hard to measure with a measuring cup also not comfortable. Datasets are taken with fake blood, food coloring and surgical drains in a house environment for dealing this problem.

Instead of measuring the edema fluid volume of the patient with a measuring cup, it is aimed to reach the pixel information of the empty part and the full part by taking a photograph of a drain whose total volume is known before.Due to our calculatins we have determined the error rate as %3 when we apply restrictions.

After the accurate measurement model had been developed, a server set up which users can upload their surgical drain photos and get their blood volume result in return. In this way foundations of the bridge have been built that can convert this project into real product.

References

- **Roozbeh Mottaghi, Connor Schenck, Dieter Fox, Ali Farhadi. See the Glass Half Full: Reasoning about Liquid Containers, their Volume and Content. In Computer Vision Foundation, 2017**
- **Pi-Yun Chen, Chia-Hung Lin, Chung-Dann Kan, Neng-Sheng Pai, Wei-Ling Chen, and 1Chih-Hsien Li. Smart Pleural Effusion Drainage Monitoring System Establishment for Rapid Effusion Volume Estimation and Safety Confirmation. IEEE, 2019.**

Acknowledgements

- **This project was completed within the context of ELE401-401 Graduation Project courses in Hacettepe University, Faculty of Engineering, Department of Electrical and Electronics Engineering.**
- **We thank Assoc. Prof. Seniha Esen Yüksel for her invaluable teachings of image Proccessing Lesson ELE492**