Lesion Meter

Berke SÜTCÜ, Orhan AYTEKİN
Supervisor: Dr. Fuat AKAL
Department of Computer Engineering, Hacettepe University

The *Lesion Meter* project aims to develop a mobile application for accurately measuring the area of skin lesions using images captured by phones. This project addresses the need for precise and efficient tools in dermatology, as current methods are often time-consuming and prone to errors, especially for irregularly shaped lesions.

Introduction to the Field

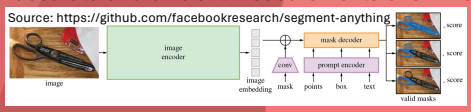
- Skin lesion measurement is a critical task in dermatology, essential for diagnosing, monitoring, and treating skin conditions. Existing methods typically involve manual measurements, which can be subjective and inaccurate, particularly when dealing with irregularly shaped or three-dimensional lesions [1].

Problem Statement

- The primary challenge addressed by the Lesion Meter project is the accurate calculation of the area of skin lesions from 2D images taken with a phone. This involves converting 2D images into a 3D model to facilitate precise area measurements.

Hypothesis and Proposed Solution

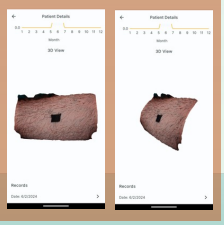
- The hypothesis for the Lesion Meter project is that a mobile application integrating advanced 3D reconstruction techniques and adaptive thresholding segmentation methods can provide accurate and efficient measurements of skin lesion areas.



- The proposed solution involves using Meshroom for 3D model generation from 2D images and combining it with adaptive thresholding and SAM for precise segmentation [2], [3].

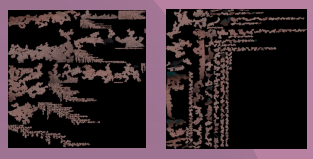
2D to 3D Conversion

- The initial step involves converting 2D images of skin lesions into 3D models. This is achieved using photogrammetry techniques. Meshroom 2023.3.0 was chosen for its robust pipeline, which includes steps such as Camera Initialization, Feature Extraction, Image Matching, and Structure from Motion.
- This process creates a detailed 3D model from a series of 2D images, allowing for more accurate measurements of the lesion's area and volume.



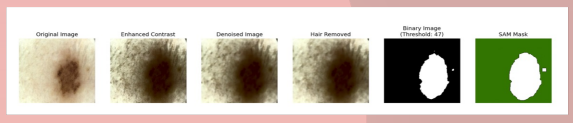
3D to 2D Unwrapping

- Once the 3D model is generated, it needs to be unwrapped to create a 2D representation for texture application. Meshroom uses a basic unwrapping method by default, which is fast and simple, making it suitable for models with more than 600k faces. This method generates multiple atlases to manage the UV coordinates effectively.
- Despite its efficiency, automated unwrapping has limitations, such as handling complex geometries and the potential need for manual adjustments to ensure accuracy.



Segmentation and Preprocessing

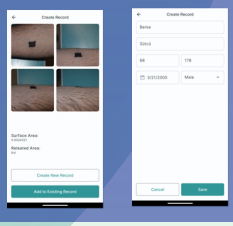
- The segmented image obtained from the unwrapping process undergoes preprocessing steps to enhance the quality and accuracy of the segmentation. This includes contrast enhancement, noise reduction, and hair artifact removal.



- The segmented regions are then further processed using adaptive thresholding with the Segment Anything Model (SAM) to accurately delineate the lesion boundaries.

Area Calculation and Conversion

- Finally, the area of the lesion is calculated from the segmented images. The number of pixels within the lesion boundary is counted and converted to square centimeters (cm^2) using the camera's intrinsic parameters.
- This conversion is essential to provide meaningful measurements for clinical use.



Results

- The results revealed significant limitations due to the dataset, which lacked sufficient images of skin lesions taken from different angles. Additionally, the quality of available images posed challenges, impacting the accuracy of 3D model generation and segmentation. High computational requirements and testing constraints further necessitated refinement. Despite these hardships, including image quality and computational power, the methods provided satisfactory results within the existing limitations.

References

[1] T. G. Debelee, "Skin Lesion Classification and Detection Using Machine Learning Techniques: A Systematic Review," *Diagnostics*, vol. 13, no. 19, pp. 3147, Oct. 2023.
[2] AliceVision, "Meshroom: A 3D Reconstruction Software," GitHub. [Online].
[3] "GitHub - facebookresearch/segment-anything: The Segment Anything Model (SAM)," [Online].

Download the Android Application

Contact us at:
b21827814@cs.hacettepe.edu.tr
b2200356002@cs.hacettepe.edu.tr

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