VeinScope

Tear Vein Pattern Analysis for Early Disease Mapping

Presented by: **Group-12**

Next Slide

PROJECT TEAM

Niwesh Sah

B23277, CSE

Aman Kumar

B23155, CSE

Md Farhan

B23155, CSE

Rohit

B23175, CSE

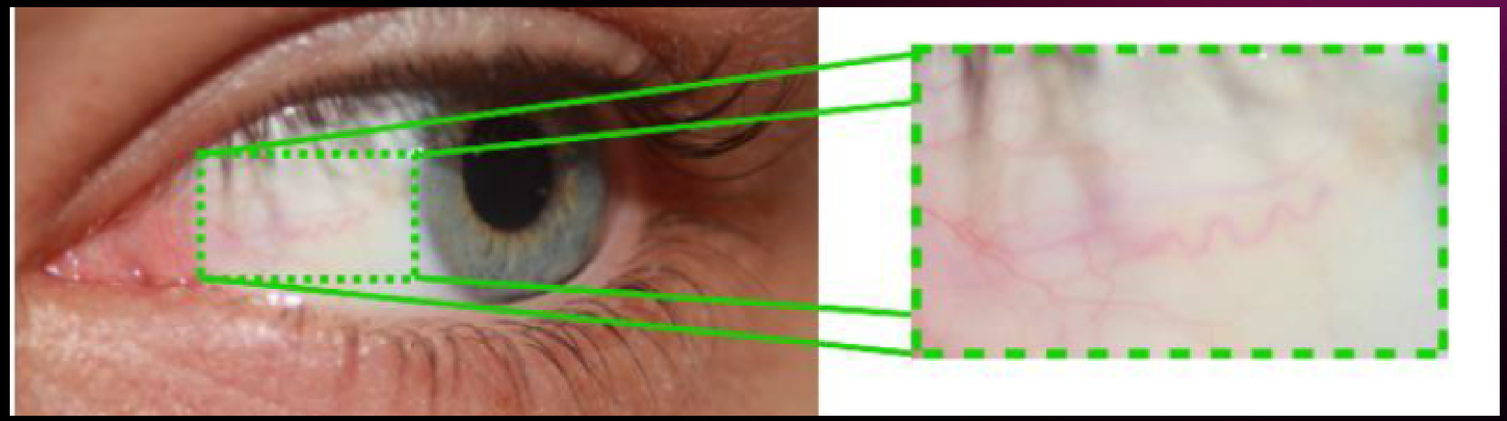
Pranav Raj

B23092, CSE

Gaurav Kushwaha

B23011, CS

Problem Overview



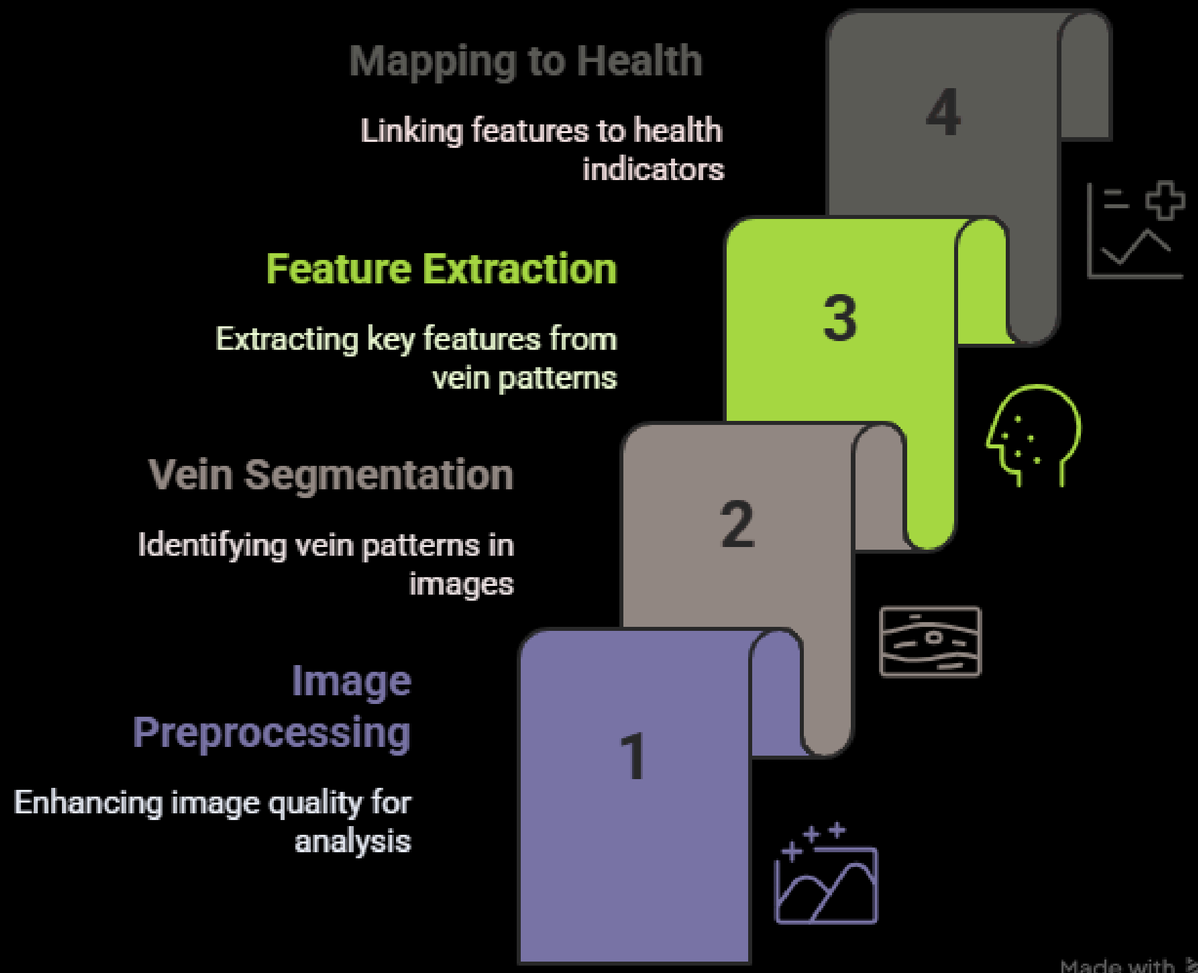
The goal is to analyze close-up eye images, especially the tear region, to:

- Segment tear vein structures
- Extract and quantify vein patterns
- Optionally map features to health indicators

Next Slide

Pipeline Components and Methods

Vein pattern analysis pipeline

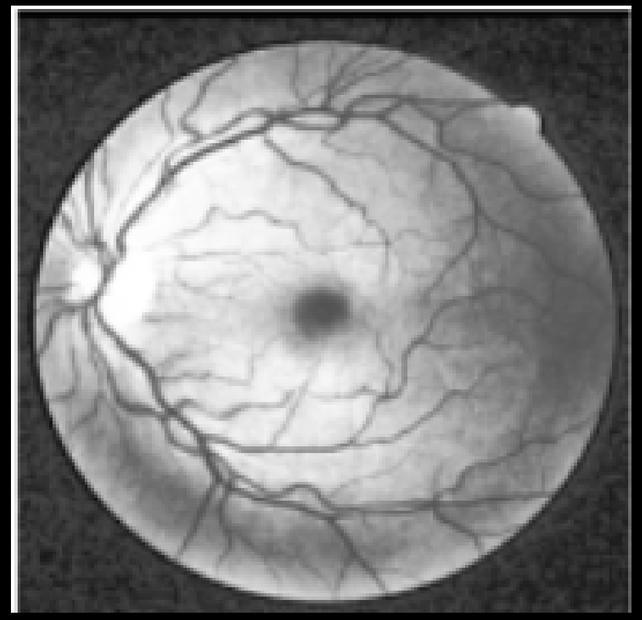


Next Slide

Image Preprocessing

Purpose:

- Improve visibility and isolate the region of interest (ROI).



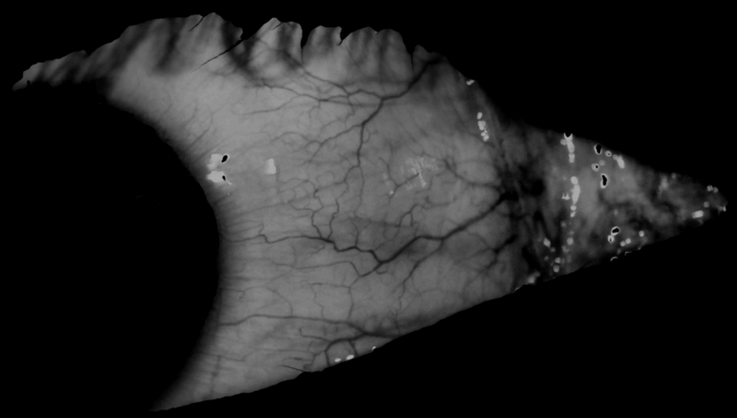
Methods:

- **CLAHE (Contrast Limited Adaptive Histogram Equalization):** Enhances contrast in small regions to make veins more visible.
- **Green Channel Extraction:** Veins show high contrast in the green channel of RGB images.
- **Grayscale Conversion + Histogram Stretching:** Improves contrast and suppresses noise.
- **ROI Cropping:** uisng sam model Use eye landmark detection or manual ROI to focus on the tear region.

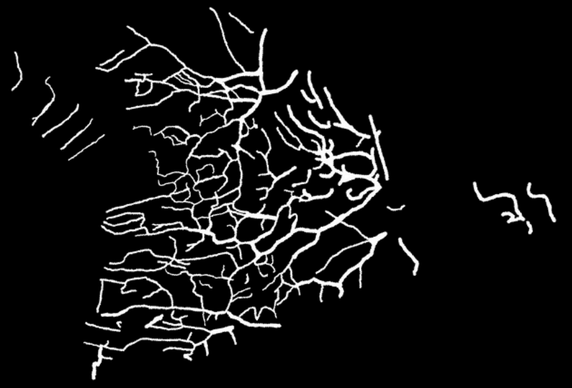
Next Slide

Image Preprocessing

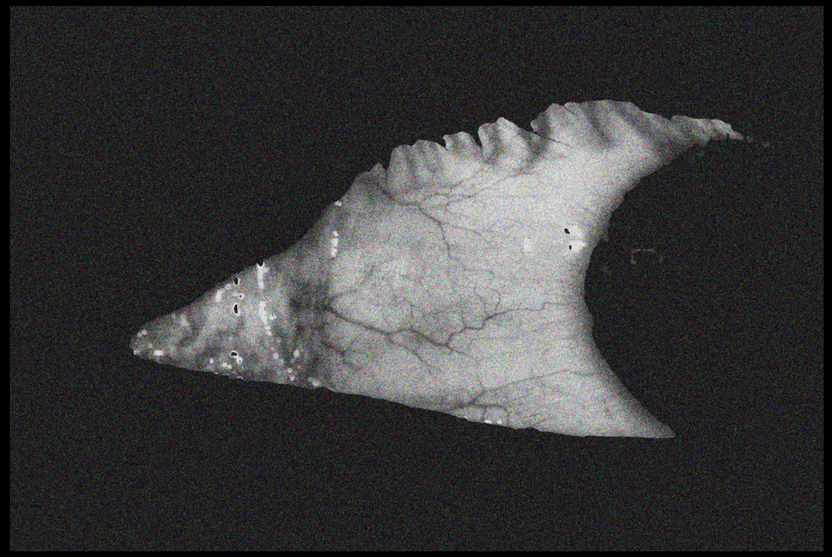
Image Augmentation



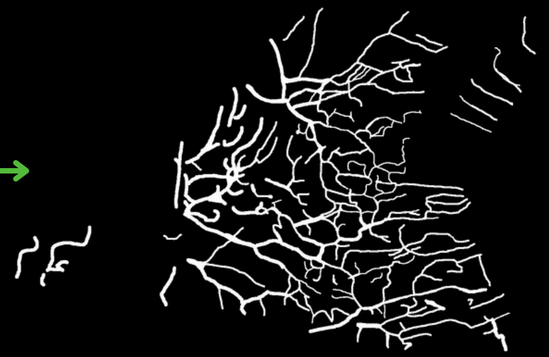
Segmented



Augmented Images

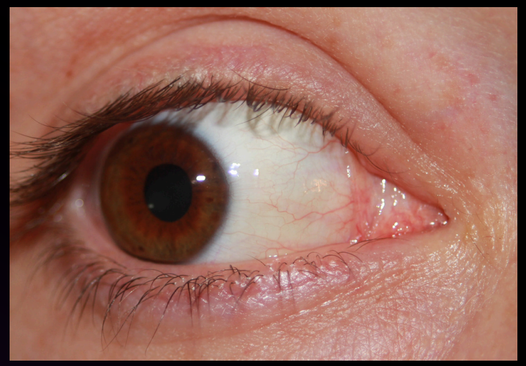


Segmented



de

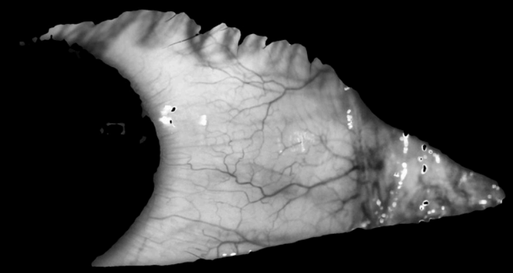
Image Preprocessing



Original

Without SAM, Green Channel Extraction (CLAHE)

with SAM



ext Slide

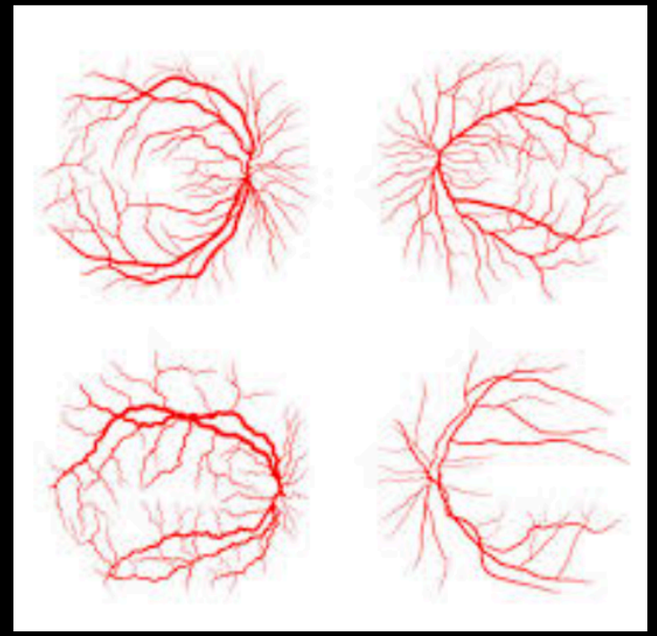
Vein Pattern Segmentation

Purpose:

- Detect thin vascular structures from images.

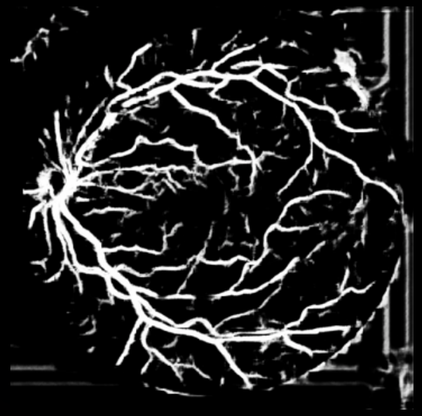
Methods:

- **U-Net:** A convolutional encoder-decoder network with skip connections—standard for biomedical image segmentation.
- **ResNet:** Pretrained on ImageNet (RGB images)
- **nnUNet:** Dynamically adjusts preprocessing, architecture, and training based on data

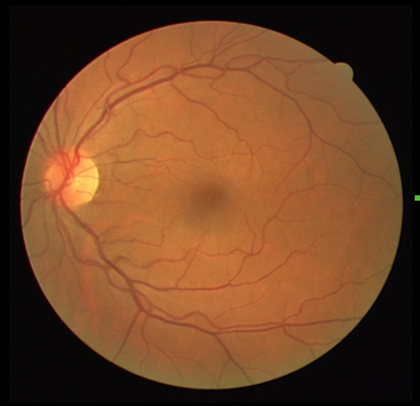


Next Slide

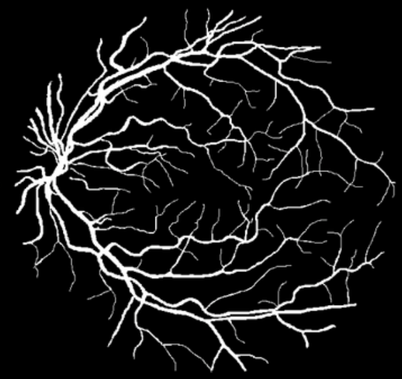
Vein Pattern Segmentation



Segmented

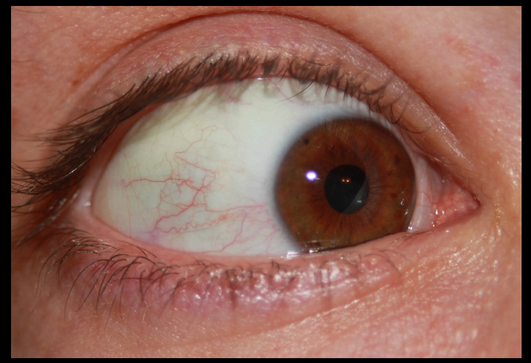


Original

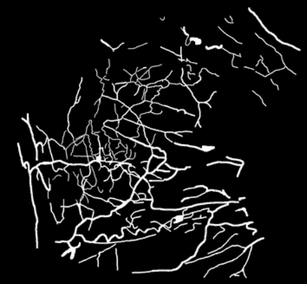


Ground Truth

Segmented



Original



Ground Truth

Feature Extraction

Purpose:

- Quantify vein patterns for downstream analysis.

Techniques:

- **Fractal Dimension:** Measures complexity of vein branching.
- **Vein Density:** Ratio of vessel pixels to total ROI.
- **Tortuosity:** Curviness of vein paths.
- **Orientation Histograms:** Angles of vessel branches to detect symmetry/asymmetry.

Next Slide

Mapping to Health Indicators

Goal:

- Associate vein patterns with risk profiles.

Approaches:

- VeinScope extracts key morphological features from the binary vein masks using scikit-image and OpenCV libraries.

3.2 Health Indicator Mapping

Based on published literature and clinical research, the extracted features were mapped to potential health indicators:

Table 3.2: Mapping of Feature Patterns to Health Indicators

Feature Patterns	Potential Health Indicators
High tortuosity & branch density	Diabetic Retinopathy
Reduced vessel width and area	Aging, Dehydration
Dense branching & thick veins	Hypertension
Irregular width & branching	Proliferative Vascular Diseases
Sparse veins, many endpoints	Circulatory blockages, Dry Eye Syndrome

These mappings are intended for screening purposes only

Next Slide

Evaluation Metrics

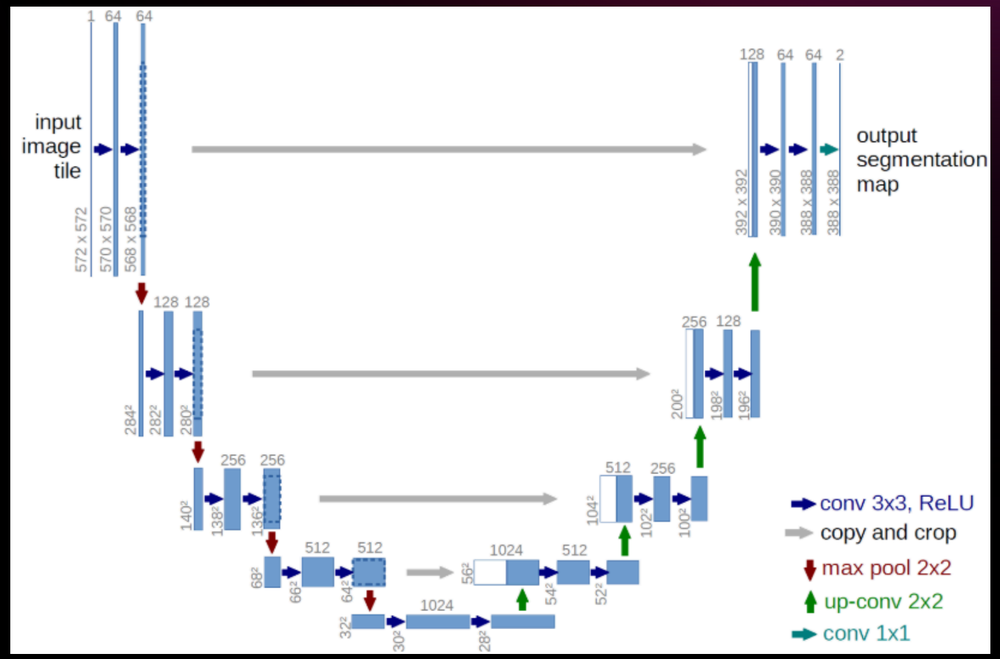

```
"results": {
    "mean": {
        "0": {
            "Accuracy": 0.9894286990493638,
            "Dice": 0.9946473725963626,
            "False Discovery Rate": 0.005464700878883969,
            "False Negative Rate": 0.005227395802334608,
            "False Omission Rate": 0.4735777695090634,
            "False Positive Rate": 0.43457998189007047,
            "Hausdorff Distance 95": 0.0,
            "Jaccard": 0.9893602428169679,
            "Negative Predictive Value": 0.5264222304909366,
            "Precision": 0.9945352991211162,
            "Recall": 0.9947726041976654,
            "Total Positives Reference": 7022765.8,
            "Total Positives Test": 7025986.266666667,
            "True Negative Rate": 0.5654200181099296
        },
        "1": {
            "Accuracy": 0.9894286990493638,
            "Dice": 0.5170947819747352,
            "False Discovery Rate": 0.4735777695090634,
            "False Negative Rate": 0.43457998189007047,
            "False Omission Rate": 0.005464700878883963,
            "False Positive Rate": 0.005227395802334608,
            "Hausdorff Distance 95": 34.90625423861219,
            "Jaccard": 0.3547015383752508,
            "Negative Predictive Value": 0.9945352991211162,
            "Precision": 0.5264222304909366,
            "Recall": 0.5654200181099296,
            "Total Positives Reference": 78677.93333333333,
            "Total Positives Test": 75457.46666666666,
            "True Negative Rate": 0.9947726041976654
        }
    }
```


Task	Metric
Segmentation	Dice Score
Qualitative	Sharpness, continuity
Health Mapping	Cluster compactness

Next Slide

Tools & Libraries

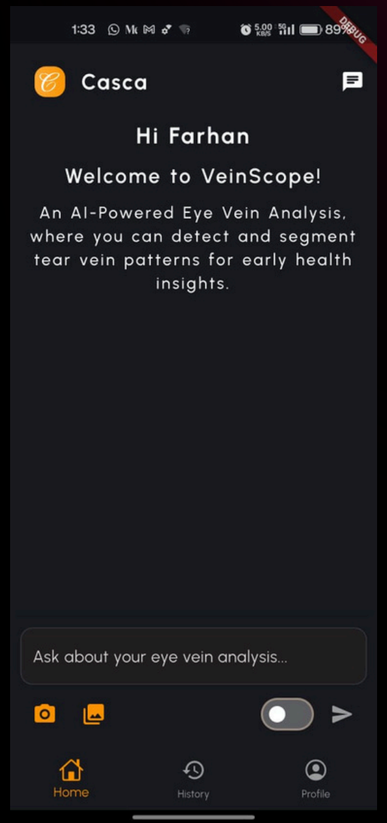
- Python, NumPy, OpenCV, scikit-image, PyTorch/Keras, Albumentations (augmentation)
- Pretrained models (U-Net)

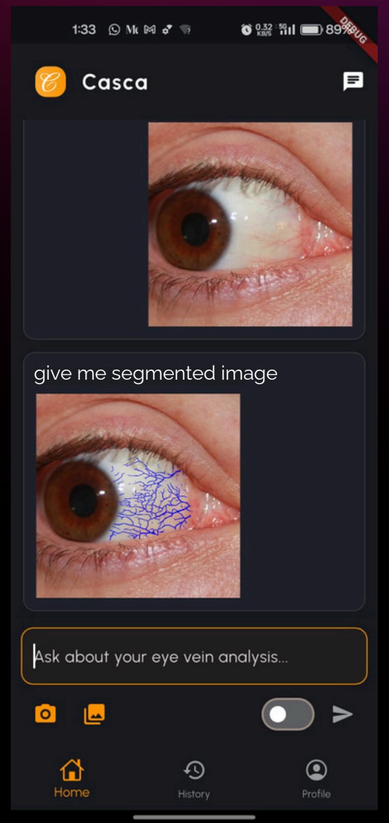


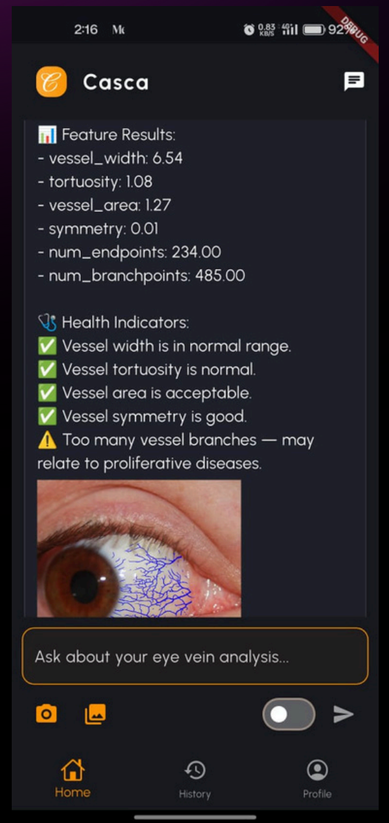
Next Slide

Our App - Casca

An Android application named “Casca” was developed to provide a user-friendly interface for the VeinScope system.







Next Slide

Thank You!