R&D PROJECT

Hemoglobin Level Estimation from Photographic images

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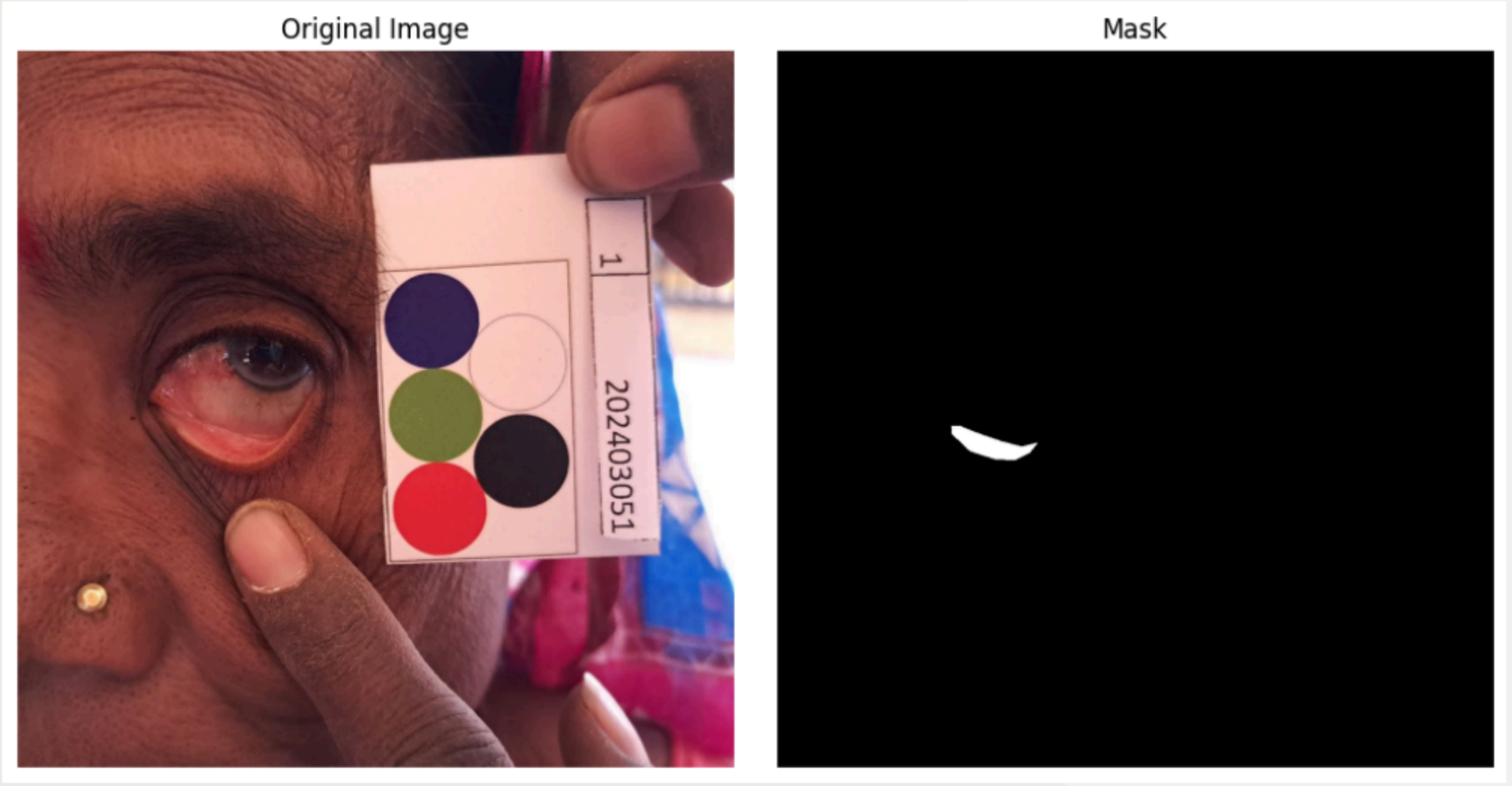
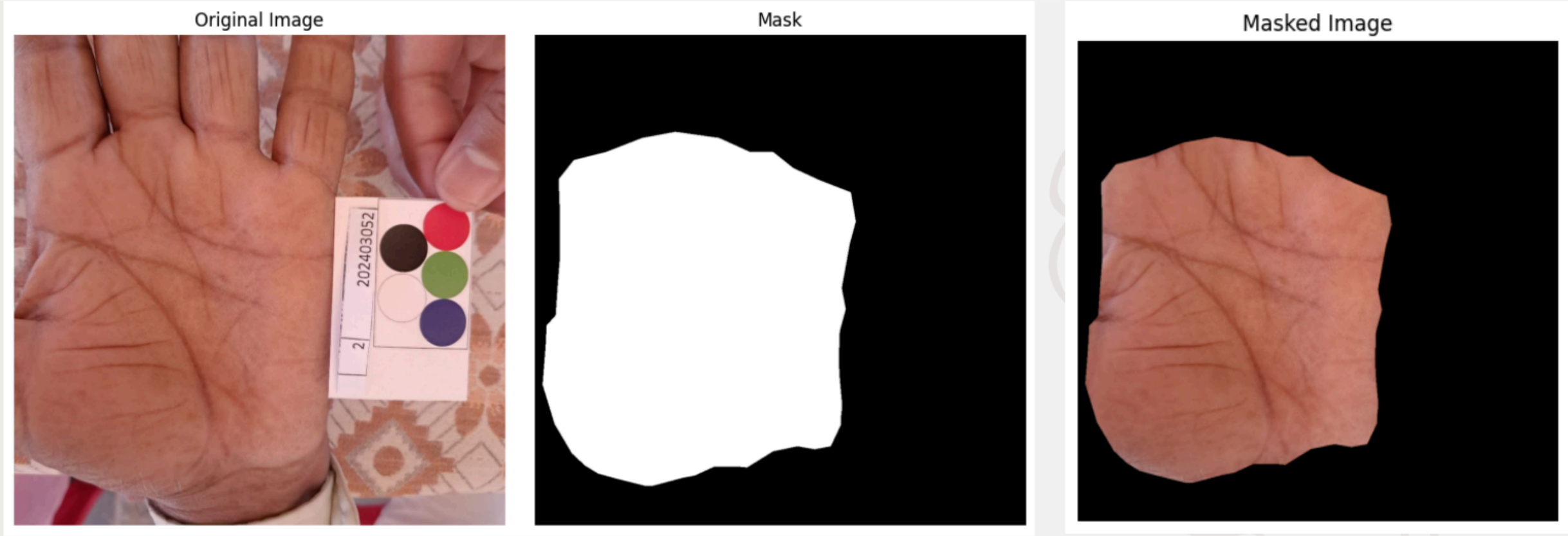
DH 307

Segmented Conjunctiva



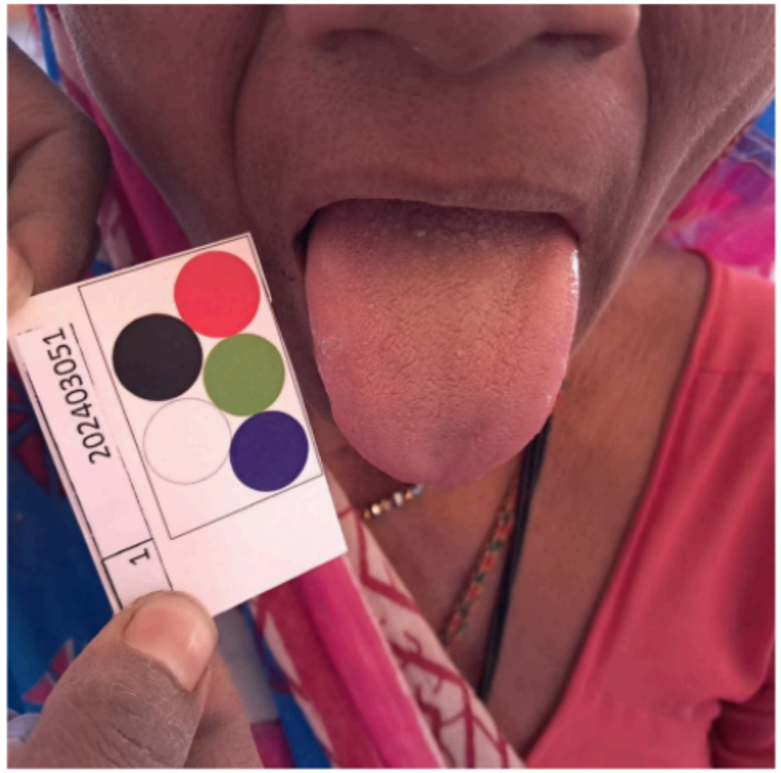
Segmented Palm



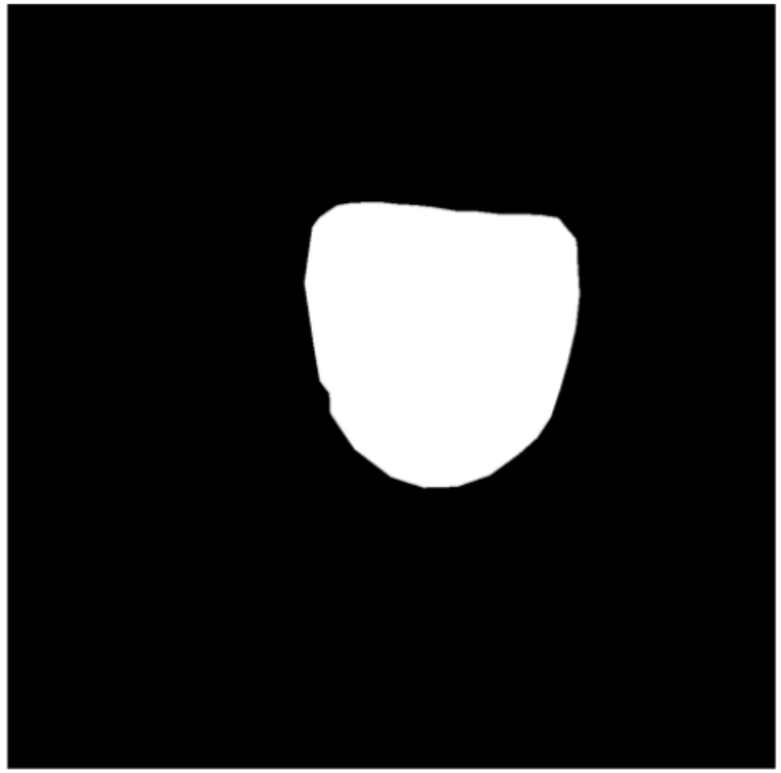
Segmented FingerNail

Segmented Tongue

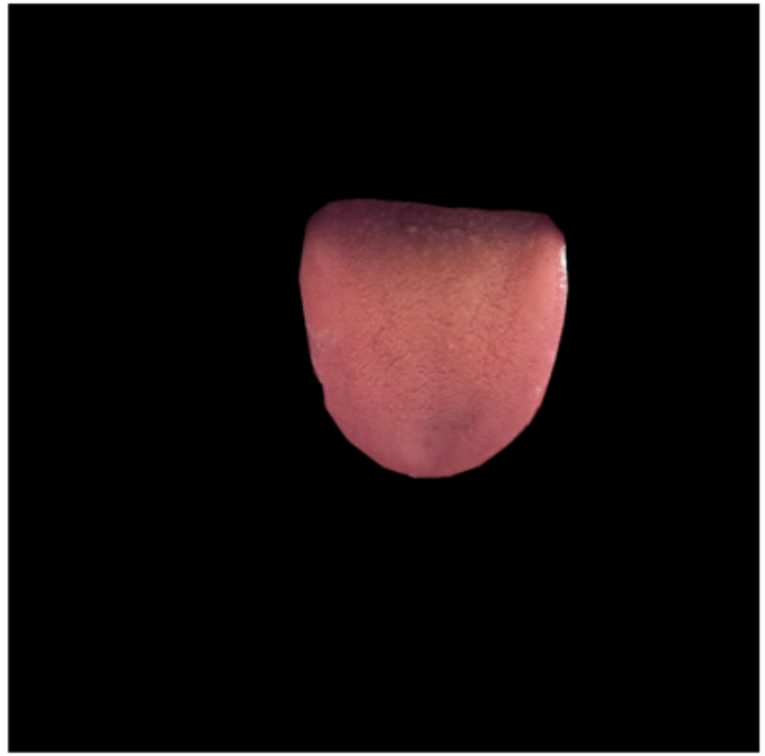
Original Image



Mask



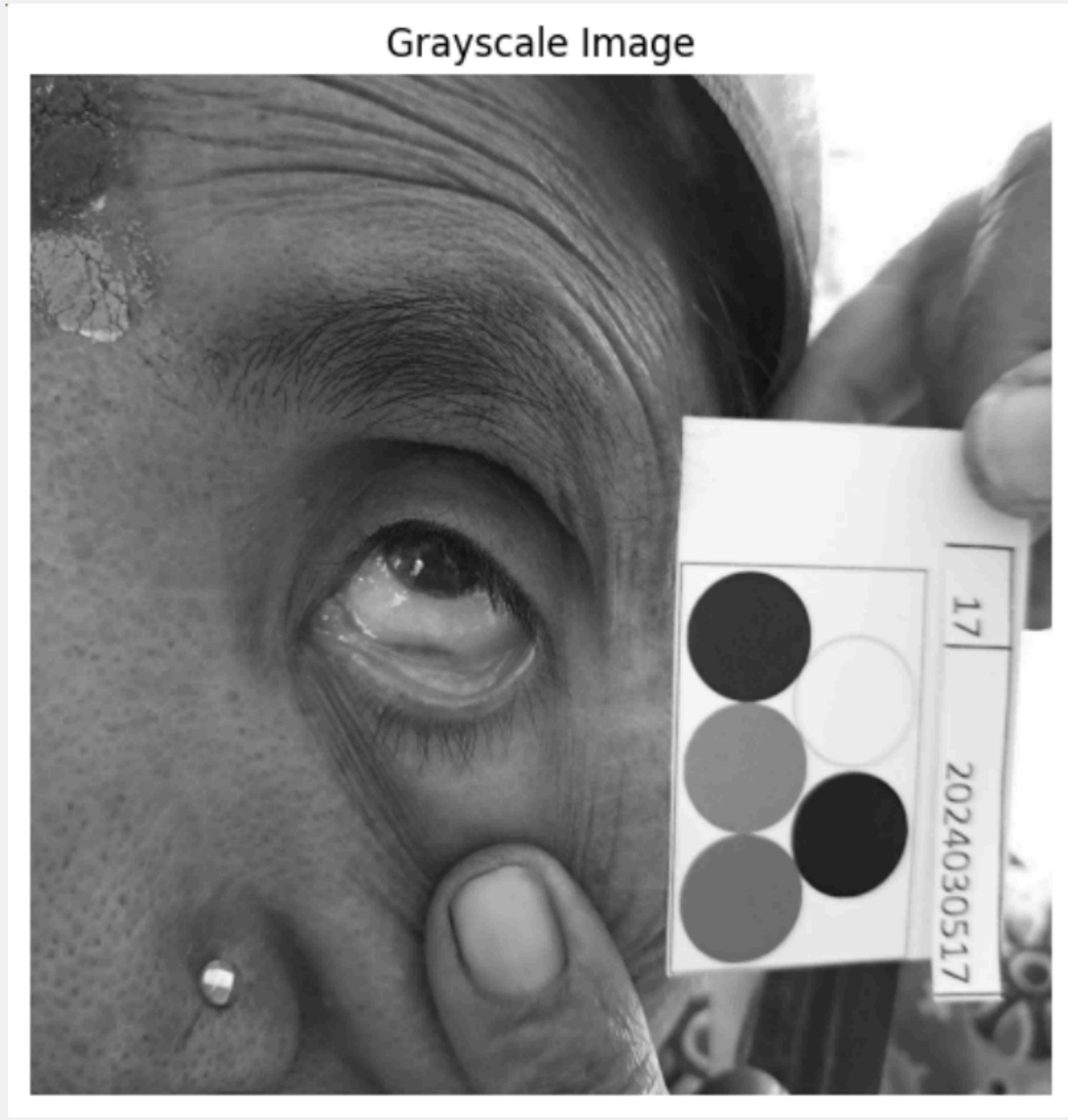
Masked Image



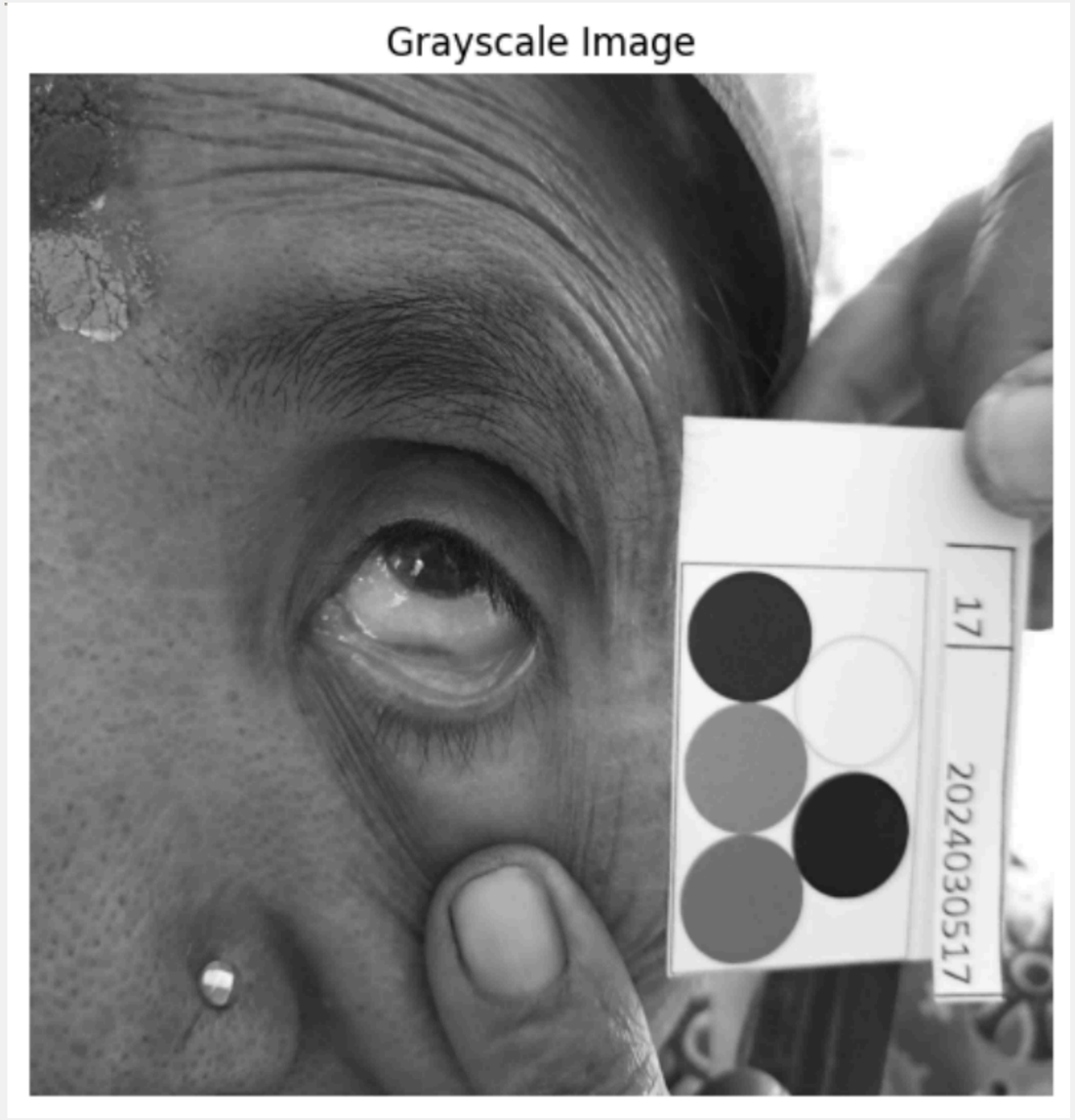
Color Palette Detection

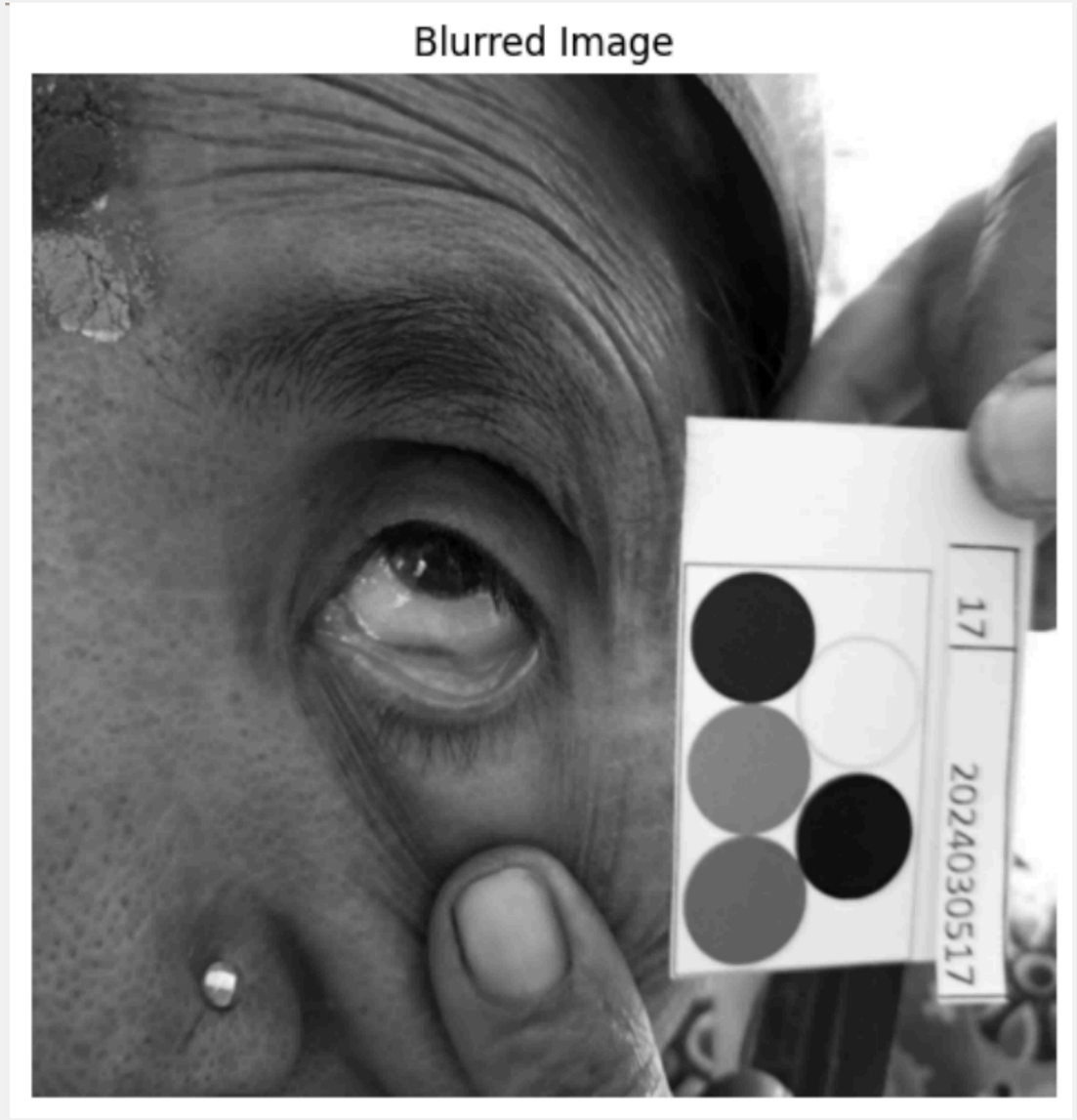
- Contour Detection
- Detection using Defined Template
- Object Detection using yolo

Contour Detection



Contour Detection

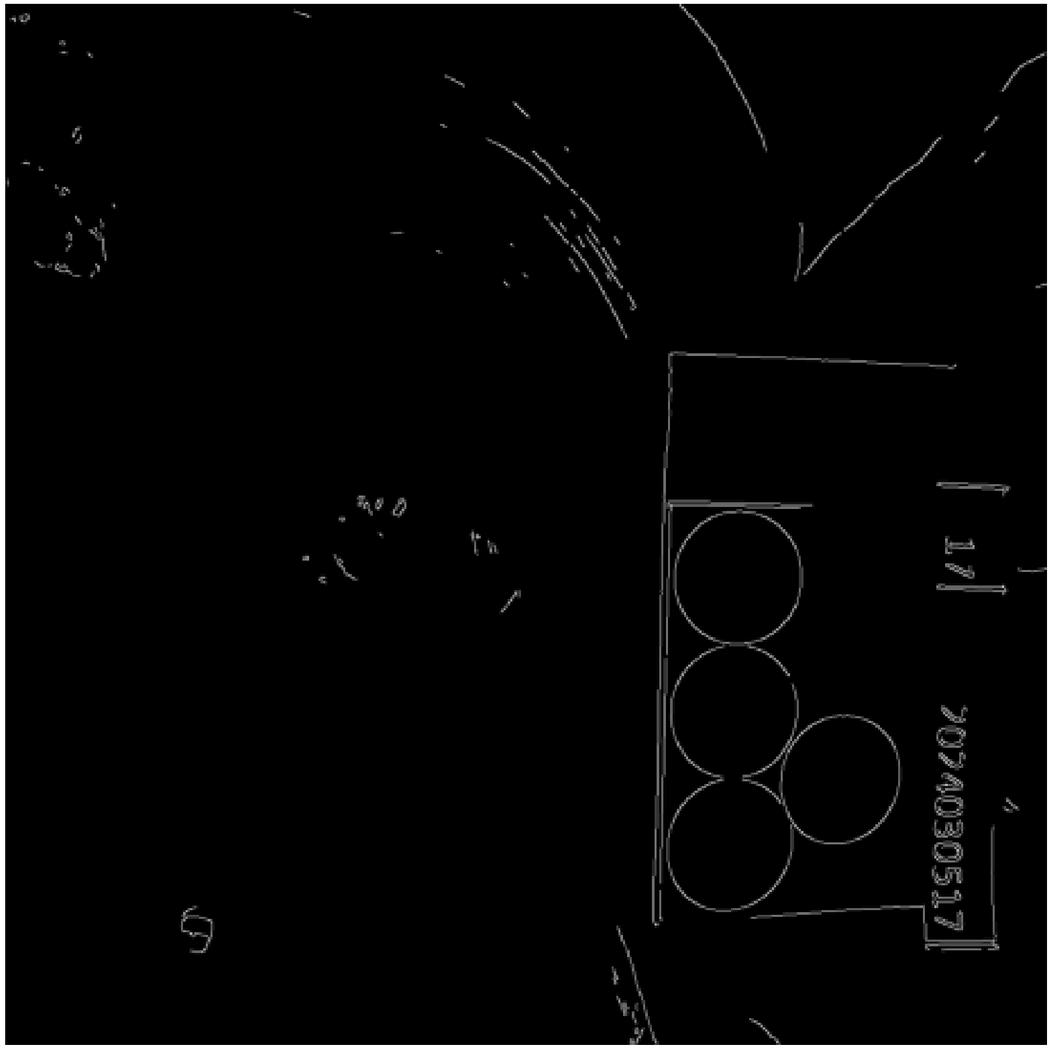




Contour Detection

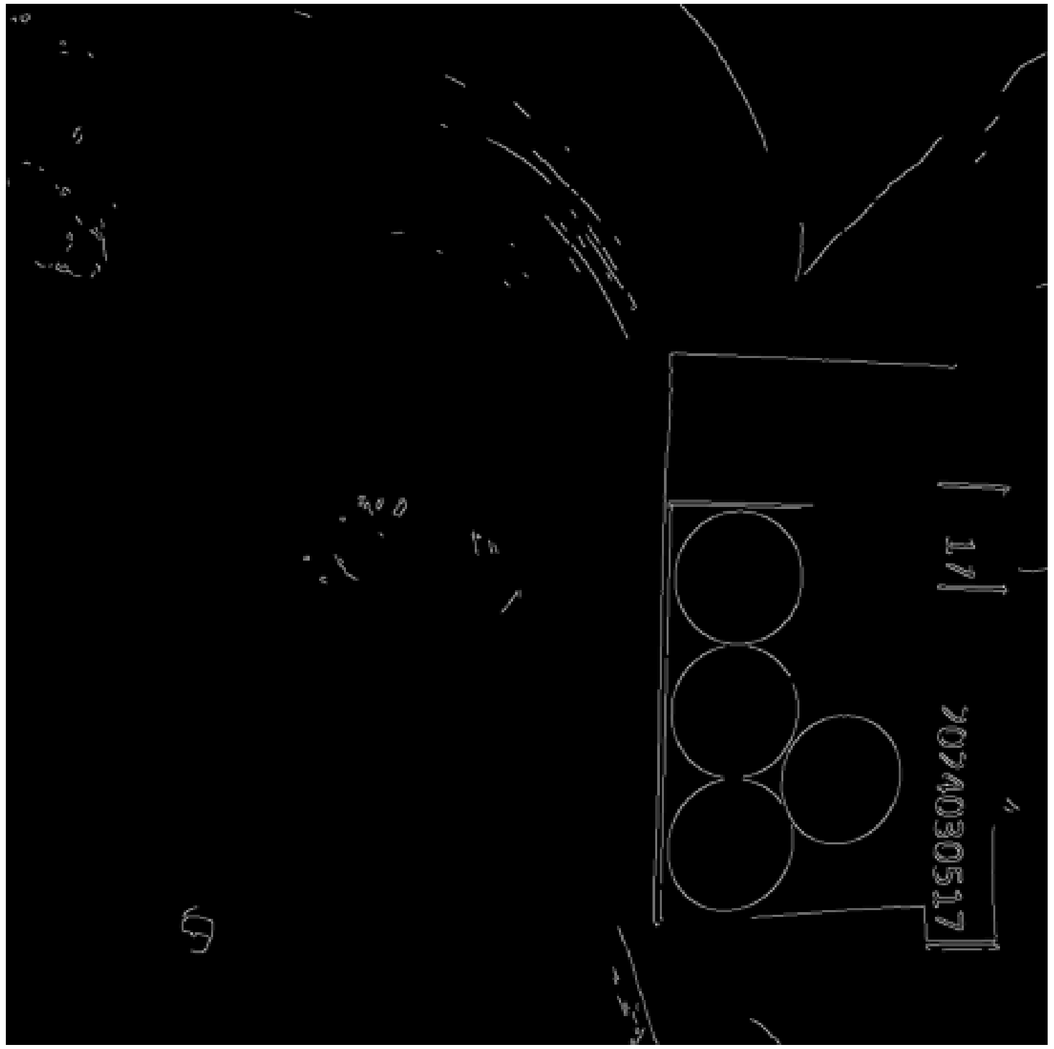
Blurred Image

Edge Detected Image



Contour Detection

Edge Detected Image



Contours Detected

Contour Detection

Contour Detection: Some good results

Original Image

Color Palette

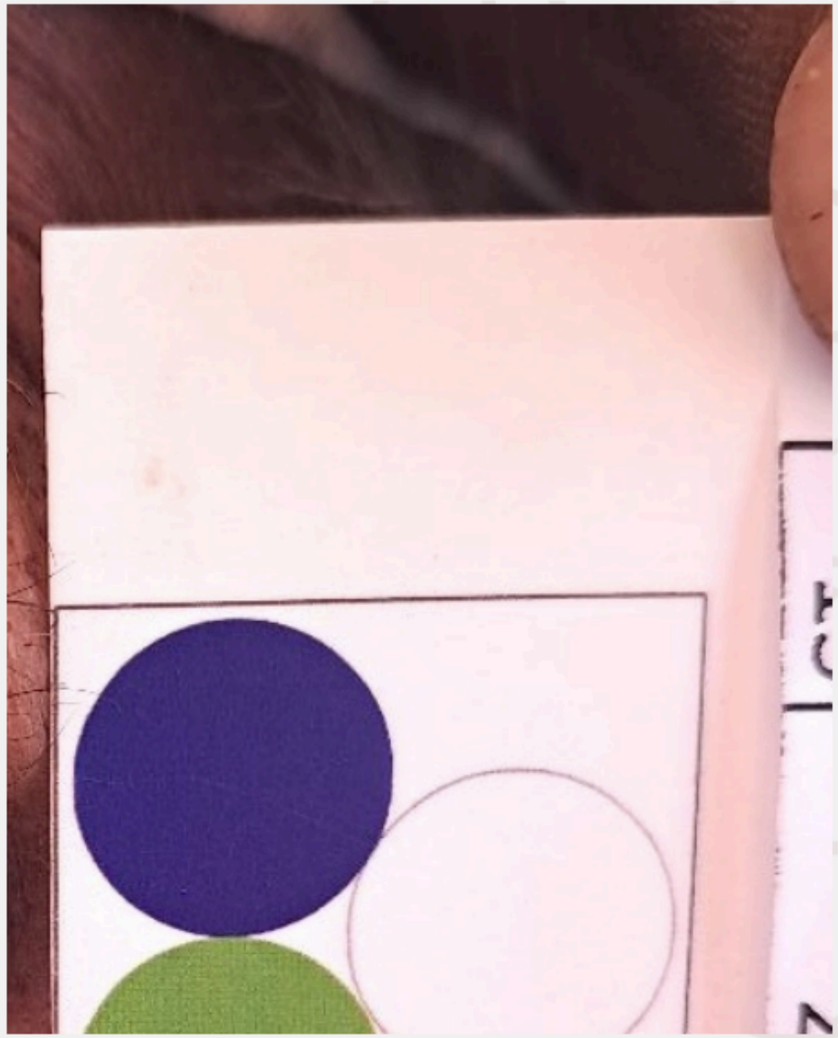
Contour Detection: Some good results

Original Image

Color Palette

Contour Detection: Problems

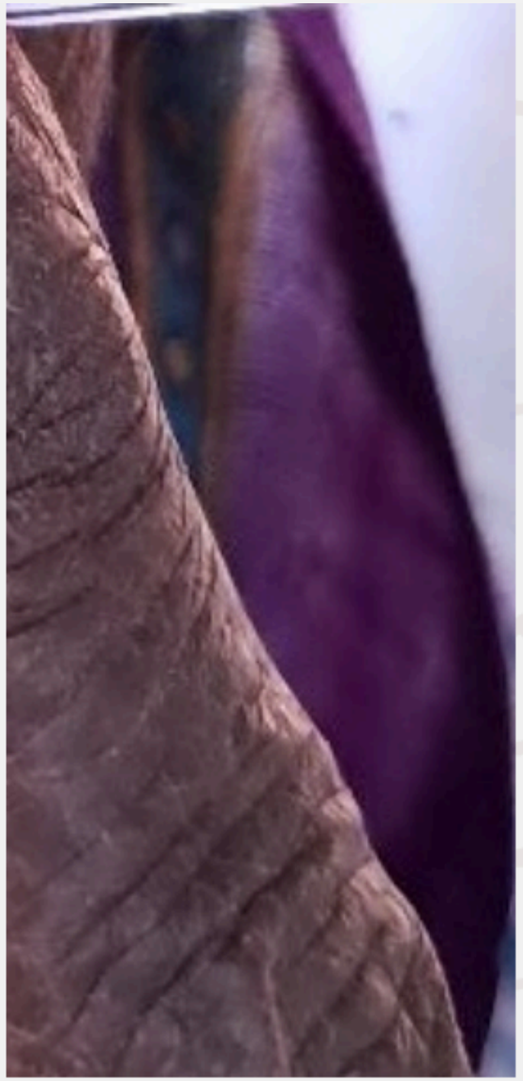
Original Image



Color Palette

Contour Detection: Problems

Original Image



Extracted Palette

Template Matching

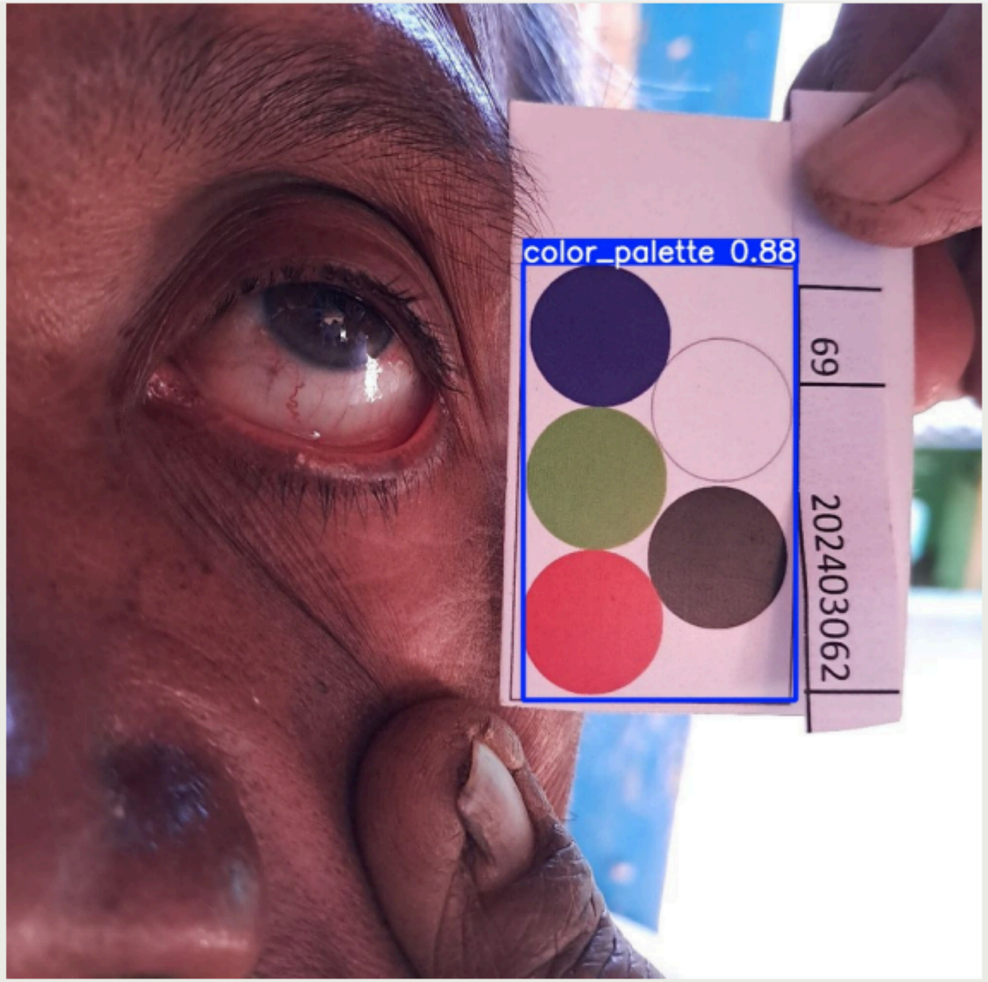
Tried using template matching to detect the palette but the performance was far worse.

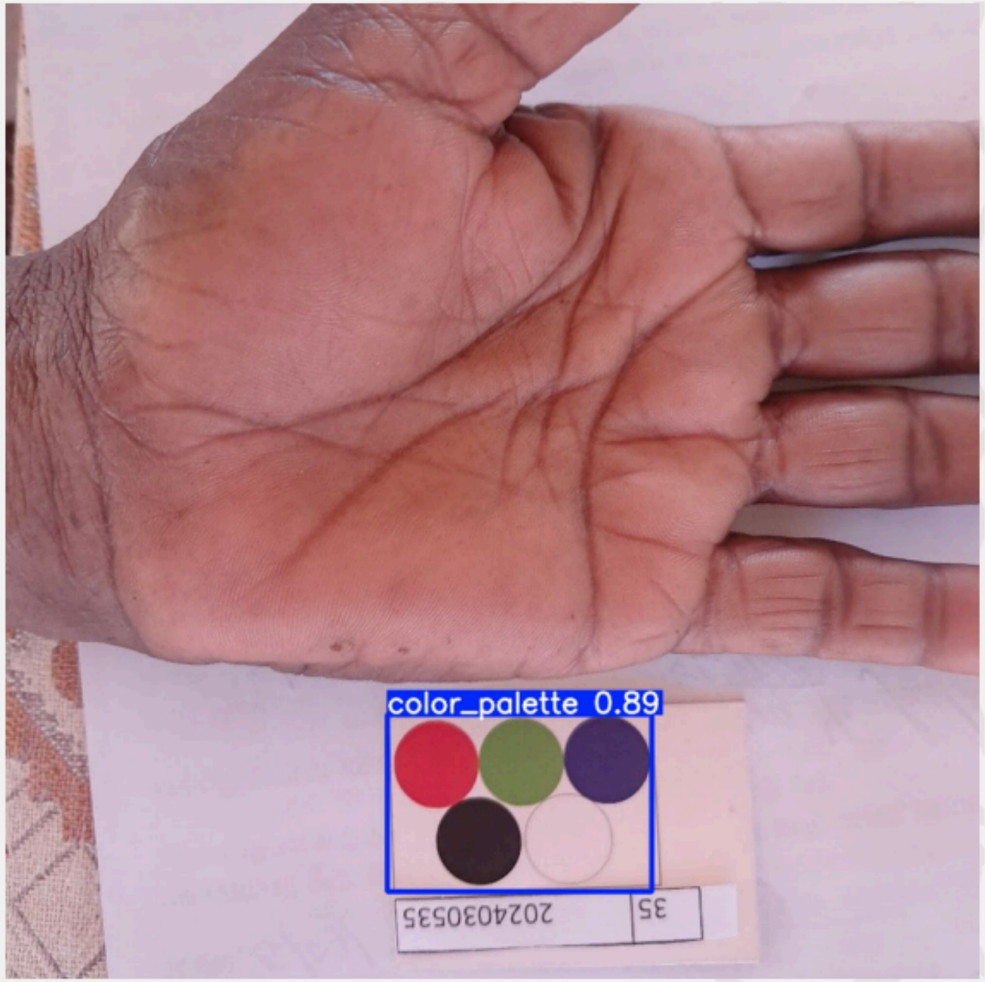
Mainly because the orientation of color palette is different in all the images.

Template

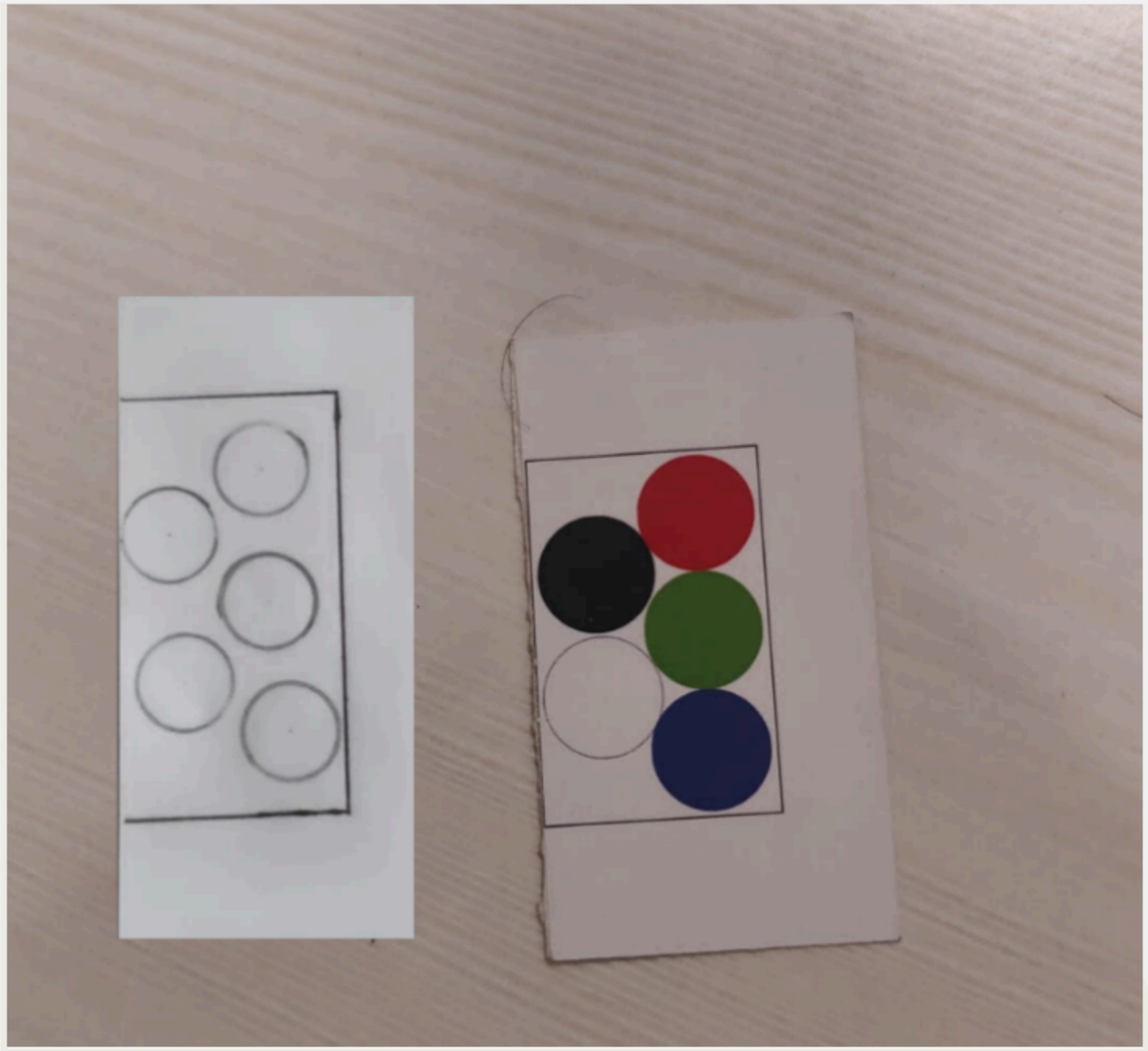
Object Detection using YOLO

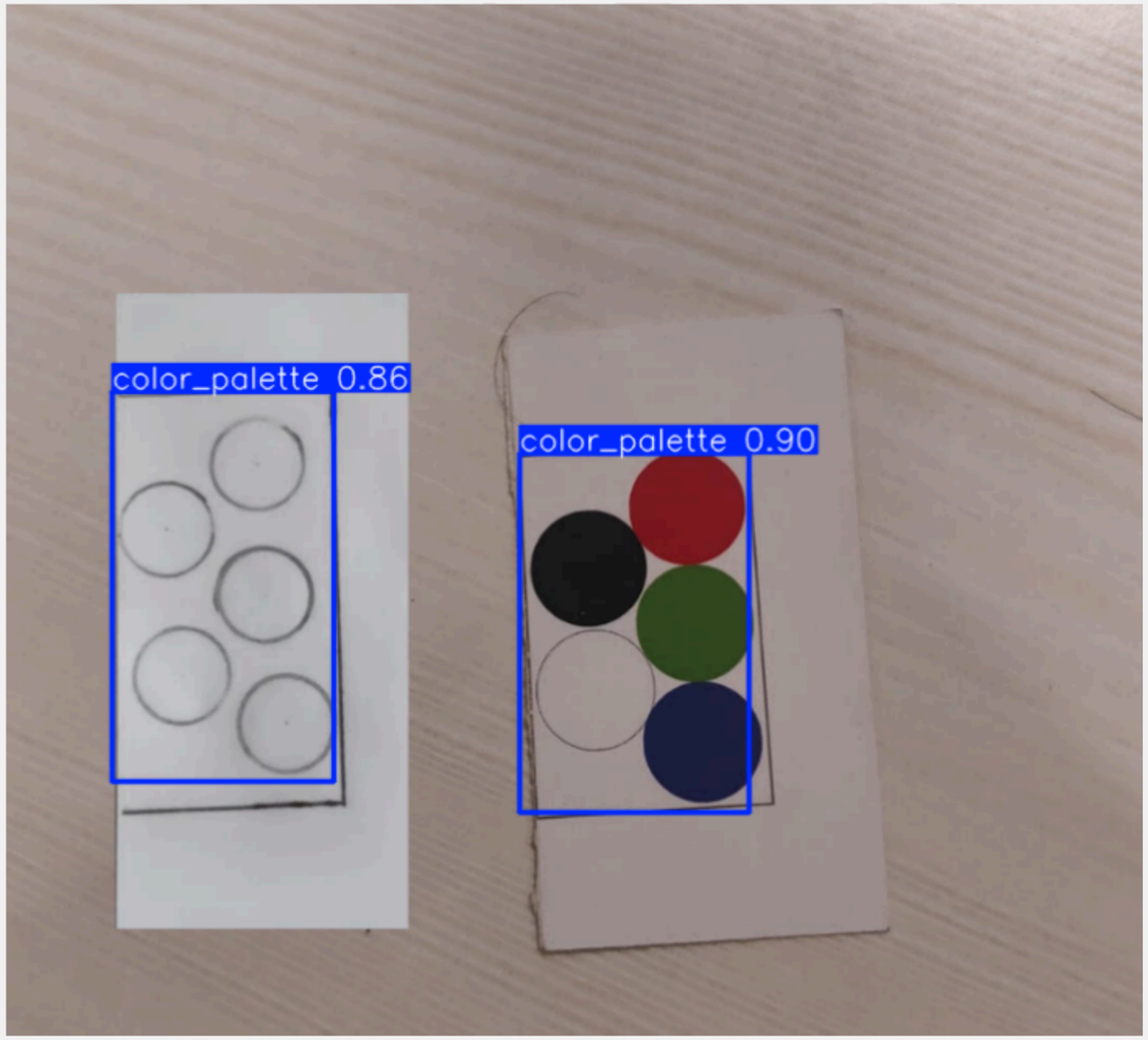
Object Detection using YOLO





Object Detection using YOLO



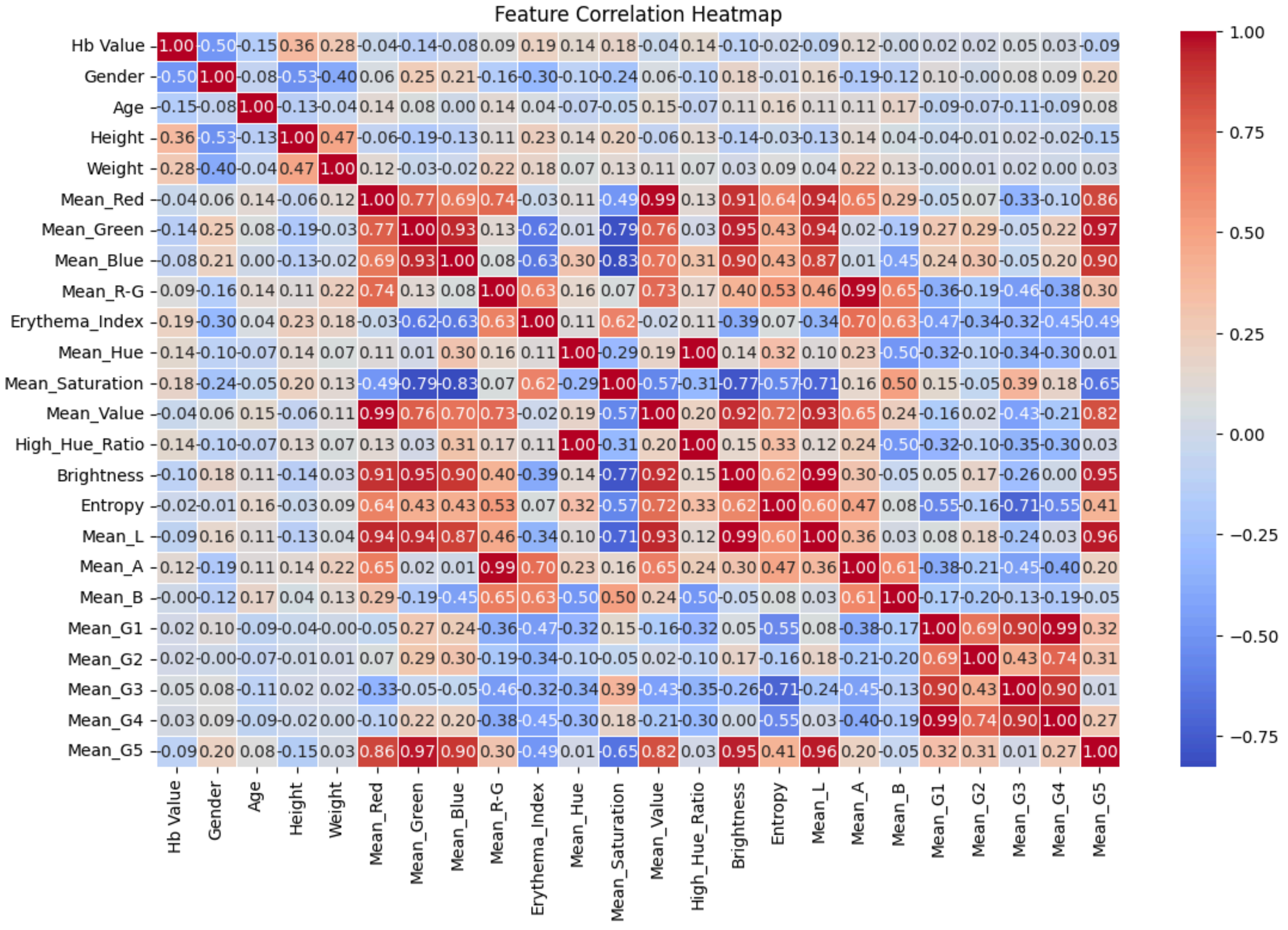


Feature Extraction

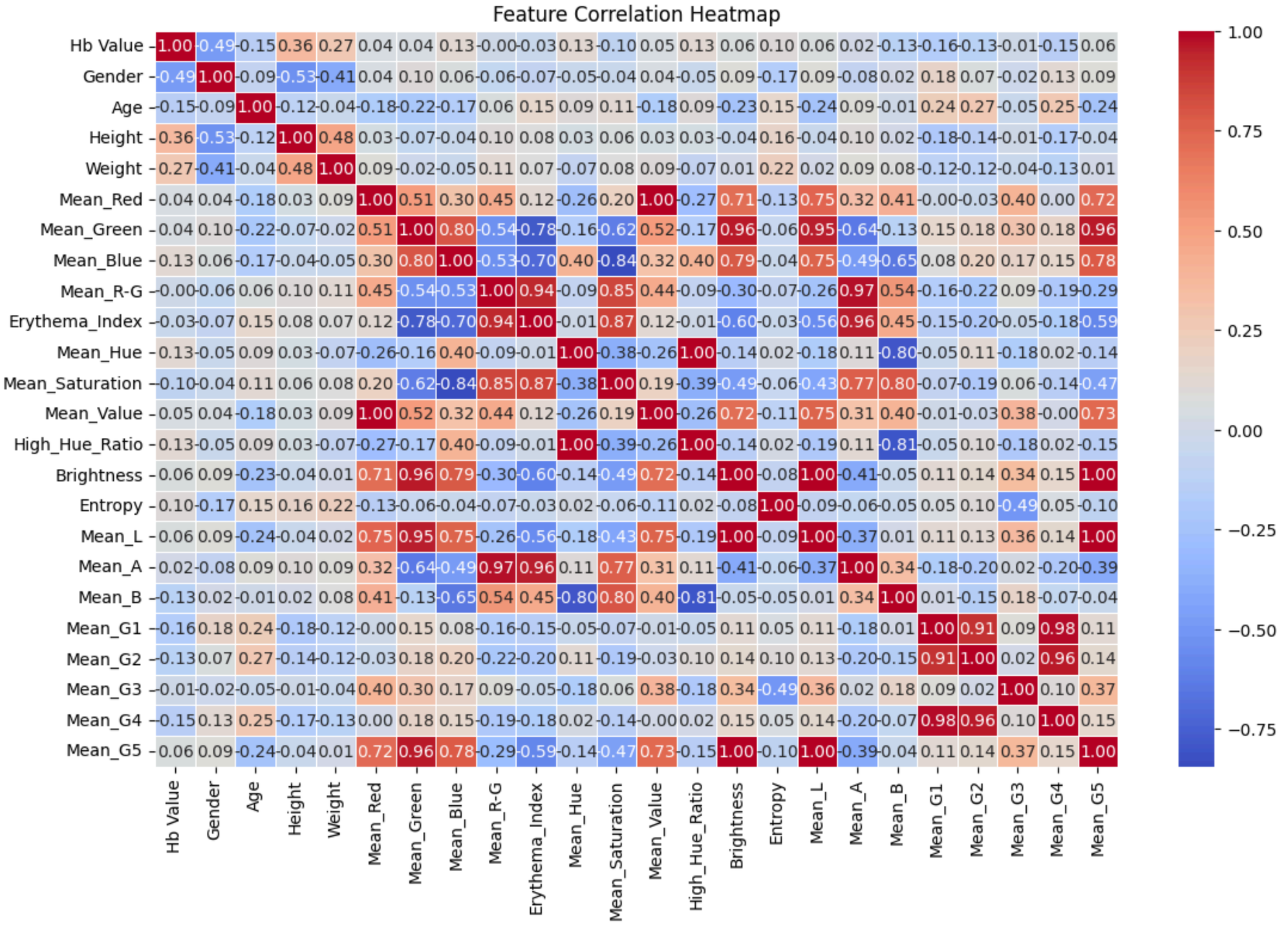
- Mean of all Red pixels
- Mean of all Blue pixels
- Mean of all Green pixels
- Mean of all Red-Green pixels
- Erythema Index
- Mean of Hue of all pixels
- Mean of Saturation of all pixels
- Mean of Value of all pixels
- Brightness
- Entropy
- Weight
- Mean of all G1 features
- Mean of all G2 features
- Mean of all G3 features
- Mean of all G4 features
- Mean of all G5 features
- Mean of all Lightness (L*) values
- Mean of all a* values
- Mean of all b* values
- Age
- Height
- Gender

Correlation

For Eye:

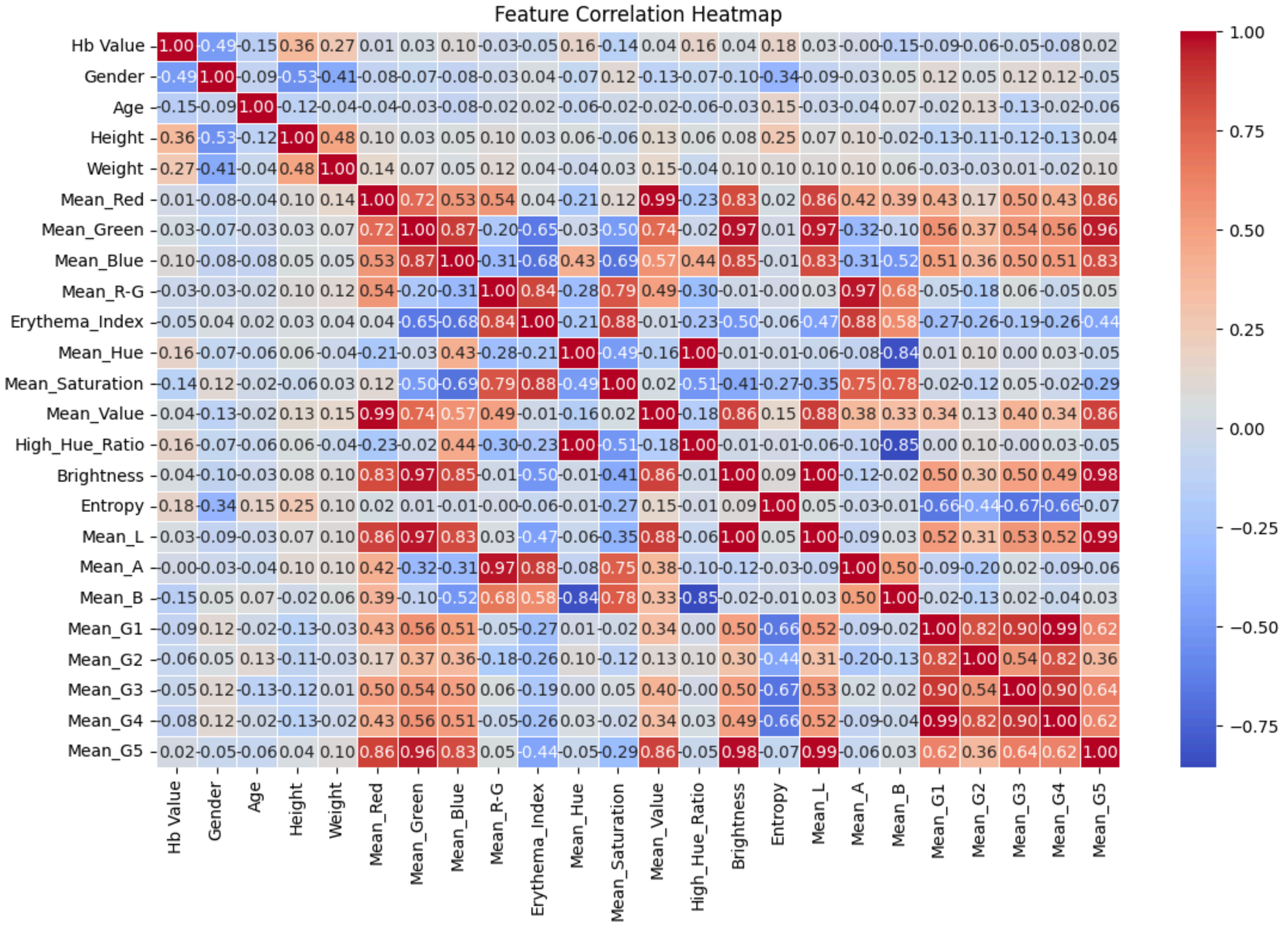


Correlation For Palm:

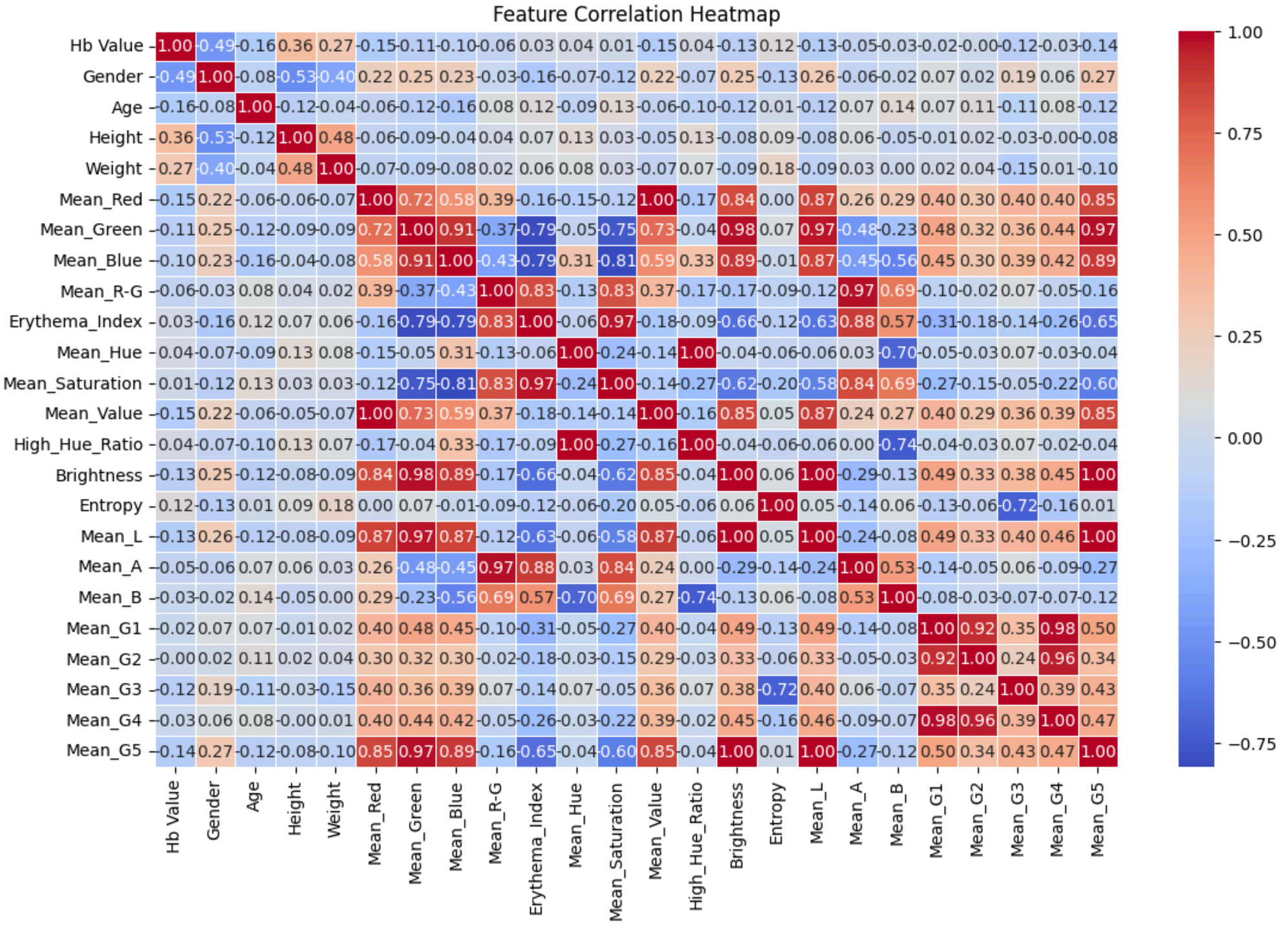


Correlation

For Fingernail:



Correlation For Tongue:



Feature Selection for eye

MRMR selected features

- 'Gender'
- 'High_Hue_Ratio'
- 'Height'
- 'Erythema_Index'
- 'Weight'
- 'Age'
- 'Mean_Hue'
- 'Mean_Green'
- 'Mean_A'
- 'Mean_Saturation'

Model	MAE	MSE	R2 Score
Linear Regression	1.108915	2.095872	0.384706
Ridge Regression	1.114775	2.111338	0.380166
Random Forest	1.250753	2.440041	0.283667
Neural Network	1.255255	2.942724	0.136092
Polynomial Regression (Degree=2)	1.265584	2.583902	0.241433

Feature Selection for eye

MRMR selected features

- 'Gender'
- 'High_Hue_Ratio'
- 'Height'
- 'Erythema_Index'
- 'Weight'
- 'Age'
- 'Mean_Hue'
- 'Mean_Green'
- 'Mean_A'
- 'Mean_Saturation'

Model	MAE	MSE	R2 Score
ElasticNet	1.278361	2.526151	0.258388
Gradient Boosting	1.307162	2.589840	0.239690
Lasso Regression	1.310444	2.592338	0.238957
Support Vector Regressor	1.366580	2.849869	0.163352
XGBoost Regressor	1.372425	2.843260	0.165292
KNN Regressor	1.466173	3.341906	0.018903
Decision Tree	1.760494	5.003457	-0.468885

Feature Selection

Using Linear Regression Model

All feature combinations in the range of 5 to 12 were tried in a loop

Features: ('Age', 'Weight', 'Mean_Green', 'Mean_Saturation', 'Mean_B', 'Mean_G2', 'Gender')

Best MAE: 1.0694

Best RMSE: 1.3819

Feature Selection

Using Linear Regression Model

All feature combinations in the range of 5 to 12 were tried in a loop

Features: ('Age', 'Weight', 'Mean_Green', 'Mean_Saturation', 'Mean_B', 'Mean_G2', 'Gender')

Best MAE: 1.0694

Best RMSE: 1.3819

Feature Selection

Using Random Forest Model

All feature combinations of 7 features were tried in a loop

Features: ('Age', 'Weight', 'Mean_R-G', 'Erythema_Index', 'Entropy', 'Mean_G2', 'Gender')

Best MAE: 1.1462

Best RMSE: 1.4585

Feature Selection

Using Random Forest Model

All feature combinations of 10 features were tried in a loop

Features: ('Age', 'Mean_Green', 'Mean_R-G', 'Erythema_Index', 'Mean_Saturation', 'Mean_Value', 'Brightness', 'Mean_A', 'Mean_G5', 'Gender')

Best MAE: 1.1795

Best RMSE: 1.4556

Future Research

RECOMMENDATION FOR NEXT RESEARCH

- Prepare Baseline Results for all the cases

Thank you