# Project Presentation and Demonstration

## Wound Detection Solution


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# Acknowledgement of Country

We respectfully acknowledge the Wurundjeri People of the Kulin Nation, who are the Traditional Owners of the land on which Swinburne's Australian campuses are located in Melbourne's east and outer-east, and pay our respect to their Elders past, present and emerging.

We are honoured to recognise our connection to Wurundjeri Country, history, culture, and spirituality through these locations, and strive to ensure that we operate in a manner that respects and honours the Elders and Ancestors of these lands.

We also respectfully acknowledge Swinburne's Aboriginal and Torres Strait Islander staff, students, alumni, partners and visitors.

We also acknowledge and respect the Traditional Owners of lands across Australia, their Elders, Ancestors, cultures, and heritage, and recognise the continuing sovereignties of all Aboriginal and Torres Strait Islander Nations.

# Overview

- Background
- Scope and Objectives
- Project Outcomes
- Border Detection Solution 1 - Machine Learning Model
- Border Detection Solution 2 - Image Processing
- Coin detection
- Wound Measurement
- Color detection

# Project Background

**MeaSURE Wound Care App**

The client requires a solution for remote wound assessment, emphasizing border and color detection. Not confined to machine learning techniques, any innovative approach that are convenient for using and maintaining is welcome. The goal is to aid doctors in evaluating wound treatment effectively.

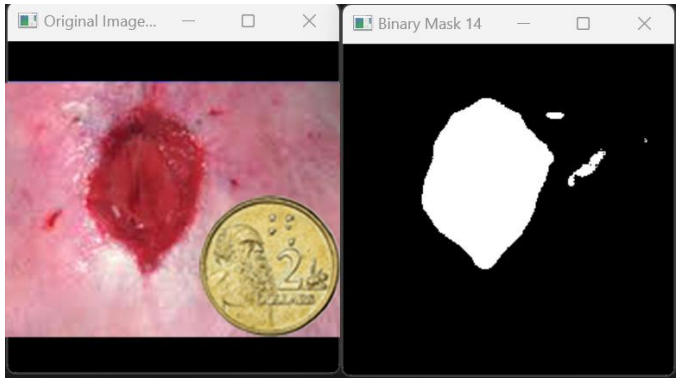
# Project Scope and Objectives

- Detect and extract wound's border from images.
- Detect wound area from the images.
- Detect reference object from images.
- Scale images to get the real size of wound.
- Extract colour from wound area.

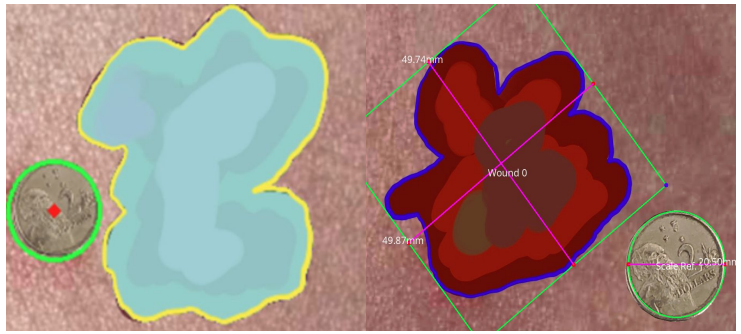
# Project Outcome/Deliverables

An image processing method to detect wound border

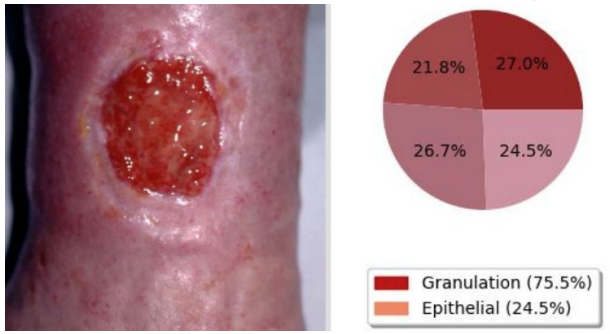

A coin detection method




A deep learning model to detect wound border




A wound scaling method to get wound size




A colour detection method

# Border Detection

# Border Detection Solution 1 - Machine Learning Model

## Image pre-processing

- Resize training images to 256*256
- Add padding to keeping original ratio
- Augmentation

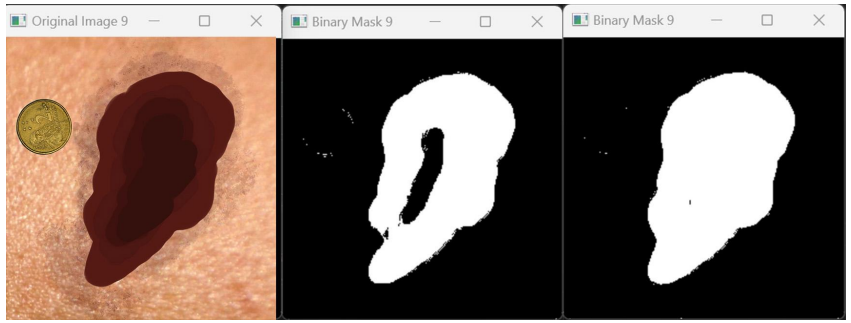
## Build and train model using U-net deep learning method

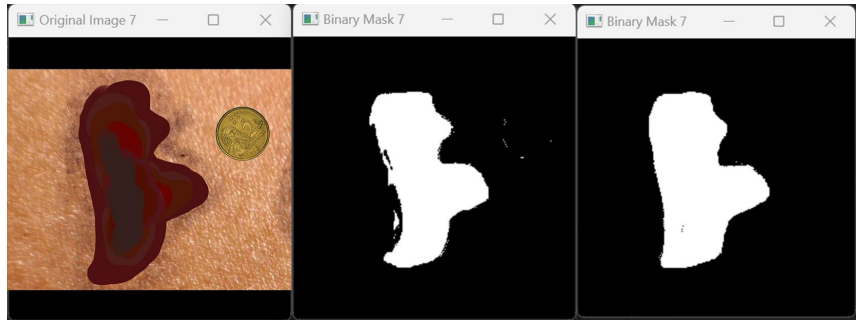
- Batch size
- Learning rate
- Epoch
- U-Net filter and layer number

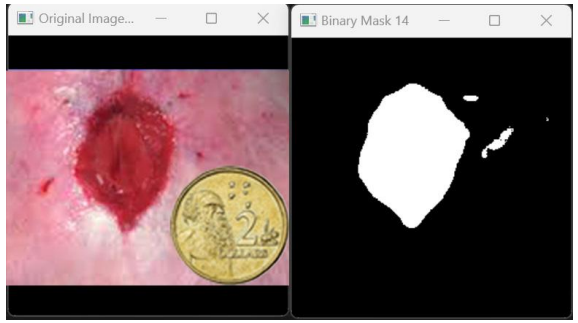
# Border Detection Solution 1 - Machine Learning Model

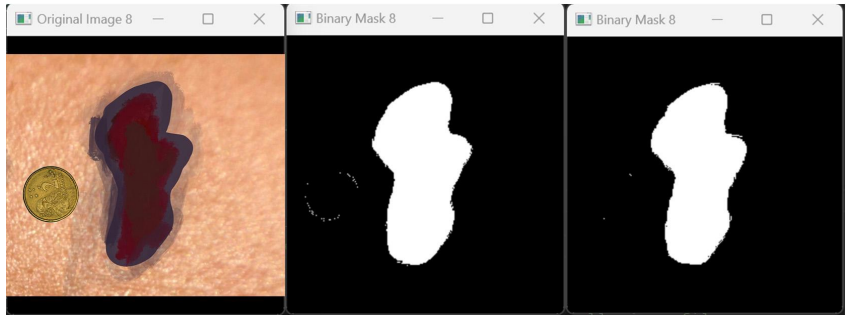
**Fine-tuning the model**

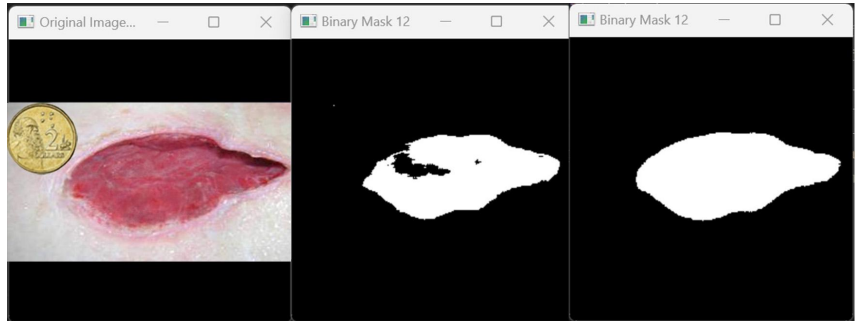
**Final results**

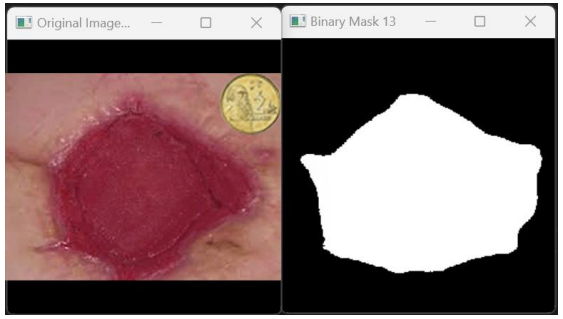


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# Border Detection Solution 2 - Image Processing

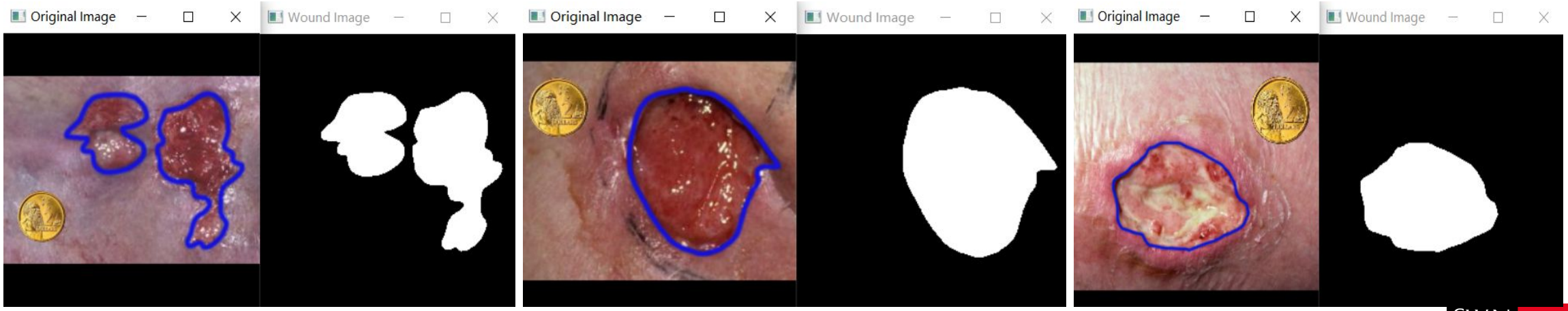
## Assumption from client

- The doctor will draw the wound outline as a pre-process of the wound image

## Method

- Traditional image processing method from OpenCV to detect the outline

## Results



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# Coin Detection

# Coin Detection

## Purpose of coin detection

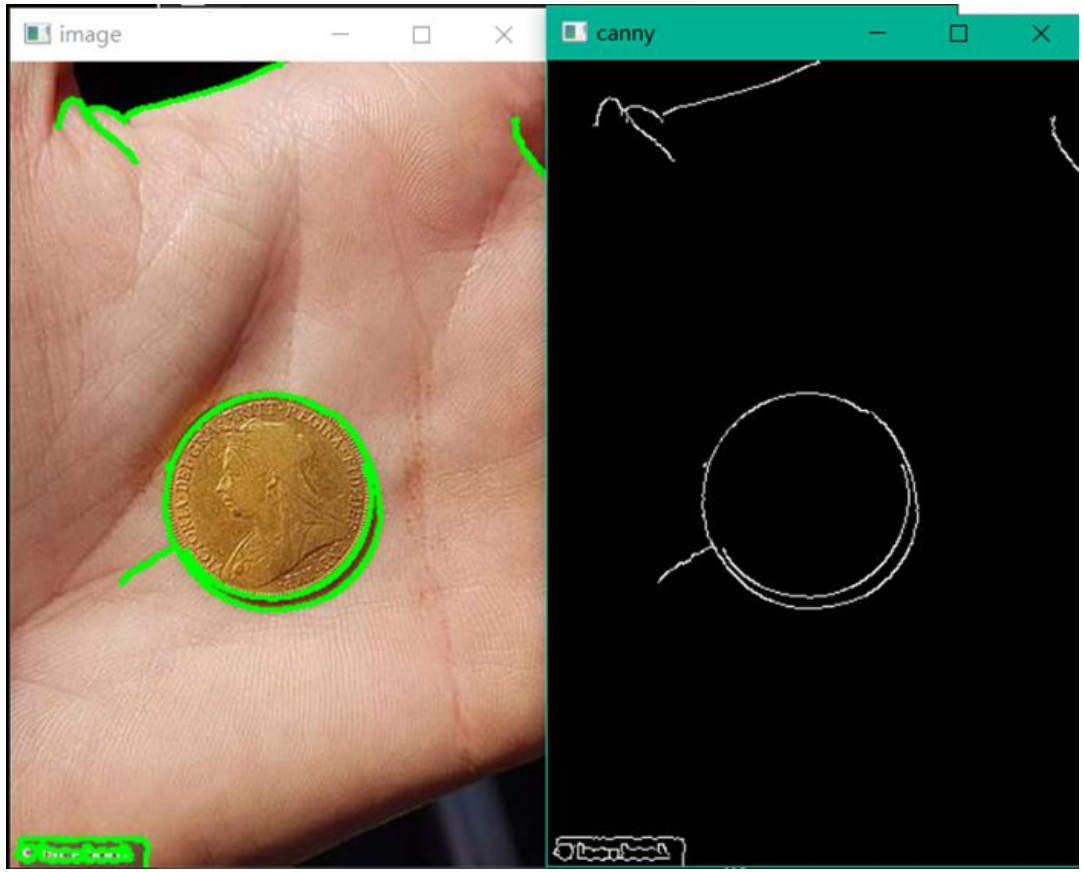
- As a reference to the true wound size
- Ease measurement

## Technology of coin detection

- OpenCV image processing technique
- Machine learning model training technique

# Coin Detection

**Iteration 1**

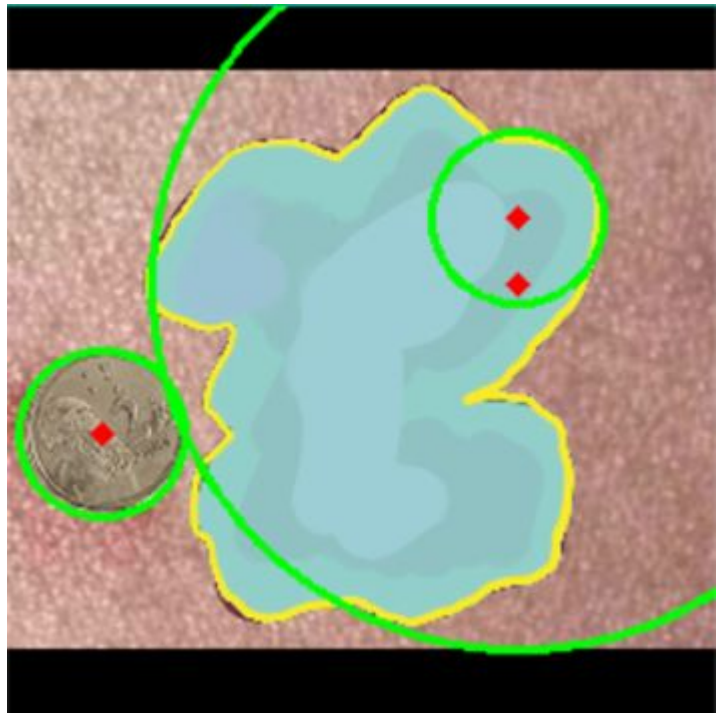


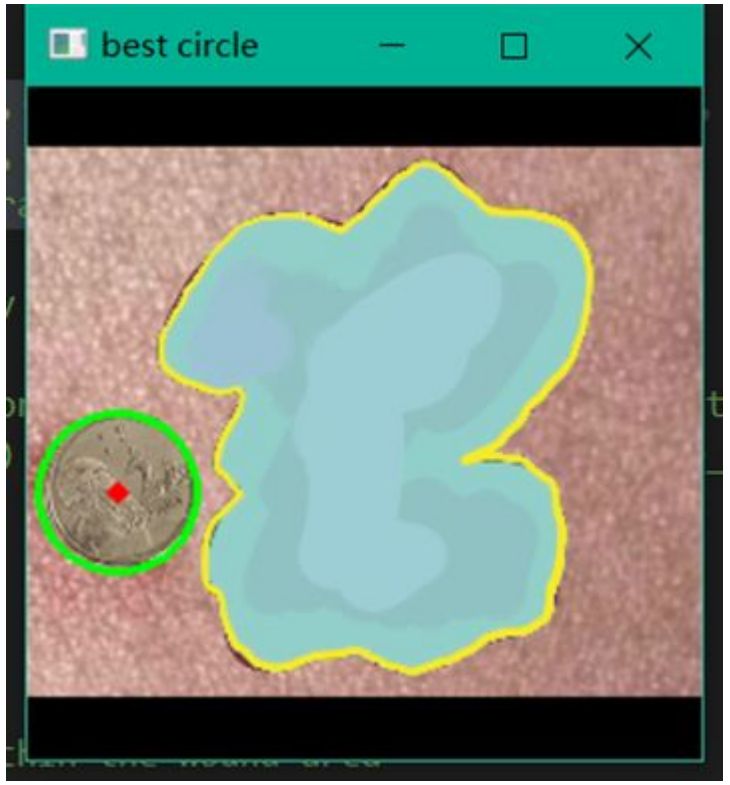
# Coin Detection

## Iteration 2

# Coin Detection

## Iteration 3





# Coin Detection

## Coin detection for actual wound size calculation

After finding the coin, some functions are used to determine the ratio of coin to image and wound to image.
As we already have the actual size of coin, it is easy to get the actual size of wound.

### Data we have:

- Coin diameter in mm.
- Accurate wound area size in pixel (imported from wound border detection)
- Image size (calculated by method in coin detection)

### Outputs:

- Area size of coin in mm^2.
- Ratio of area coin/ image.
- Ratio of area wound/ image.
- Wound area in mm^2 calculated by:
  Wound area = coin area / (coin/image ratio) * (wound/image ratio)


```
coin area is :615.7521601035994
coin/image ratio is :0.06237837655441472
wound/image ratio is :0.3165949111340471
wound area is :3125.1855398727876
```



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# Wound Measurement

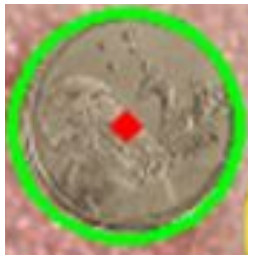
# Wound Measurement

**The real-world measurements of circulating coins are well documented**


Australian $2 Coin Diameter:

20.50 millimetres

**And after border detection we can calculate the diameter in pixels**



Extracted Border Diameter:

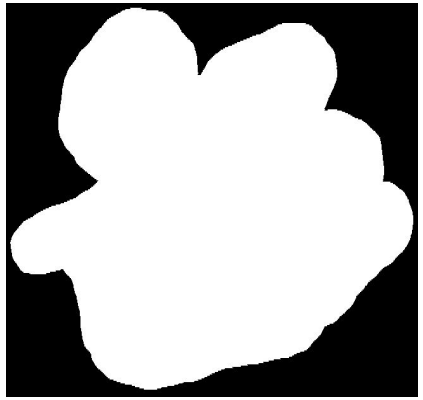
122 pixels

**We can determine how many image pixels represent 1 millimetre in real-world space**

$$pixels\text{-}per\text{-}millimetre = \frac{image\ width}{known\ width} \qquad pixels\text{-}per\text{-}millimetre = \frac{122\ px}{20.5\ mm} \qquad 1\ pixel = \mathbf{5.951\ millimetres}$$

# Wound Measurement

**We can then use the pixels-per-millimetre ratio to calculate the measurements wounds**

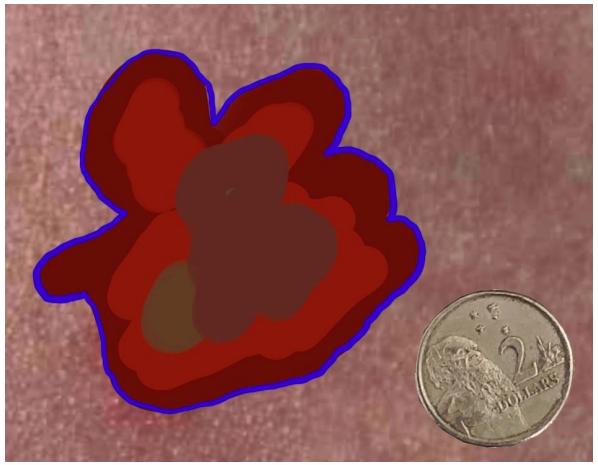


```
Measurements for Wound 0:
  Wound Length X: 601.76px
  Wound Length Y: 603.33px
  Wound Area: 251975.50px^2
```

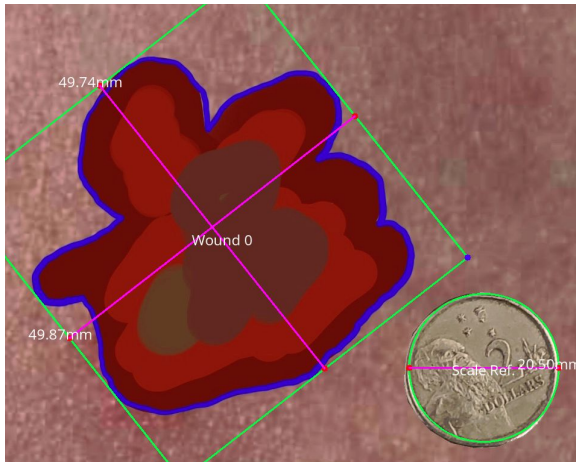
**Dividing the pixel measurements by the pixels-per-millimetre ratio converts it to millimetres**

$$size\ in\ millimetres = \frac{size\ in\ pixels}{pixels\text{-}per\text{-}millimetre\ ratio}$$

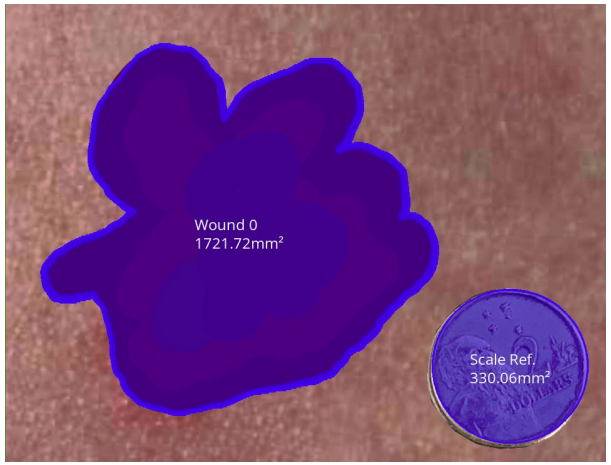
**Original**



**Length & Width**

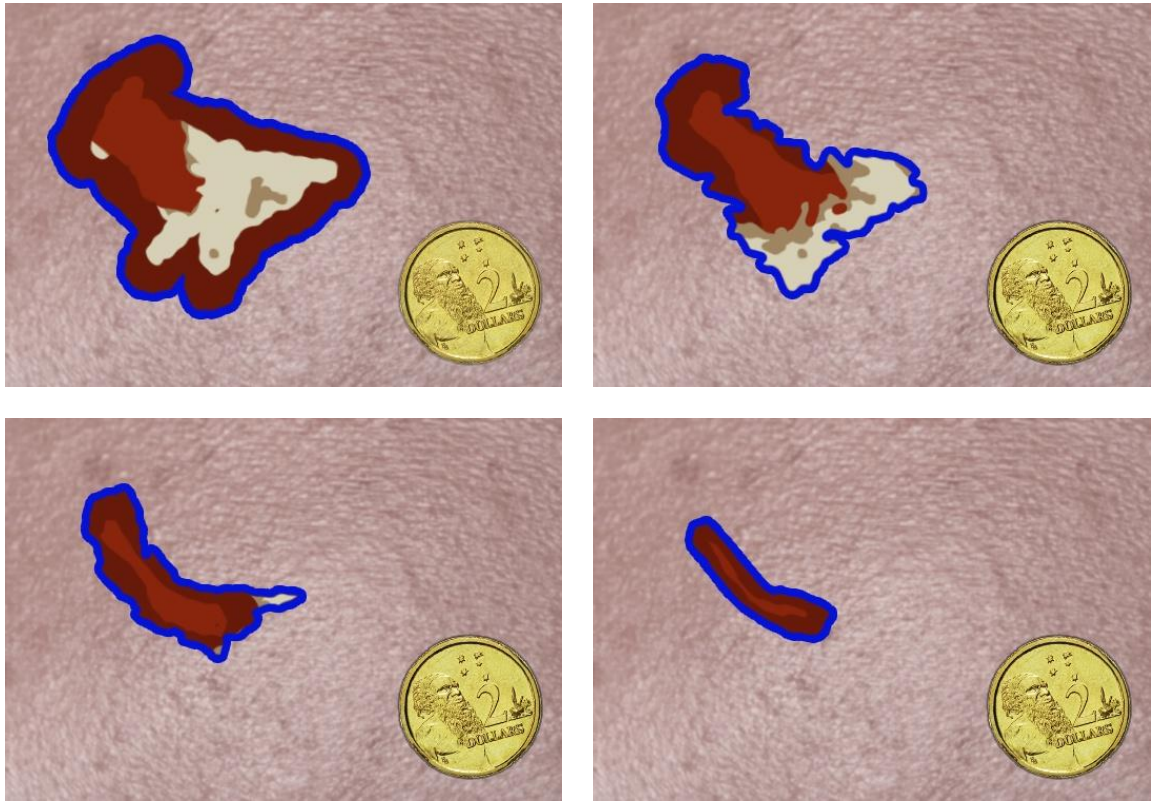



**Area**



# Measurement

**Data can also be saved and loaded to compare results and plot wound progression**

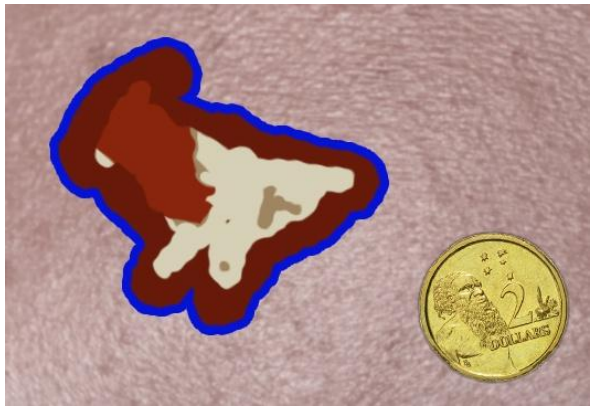



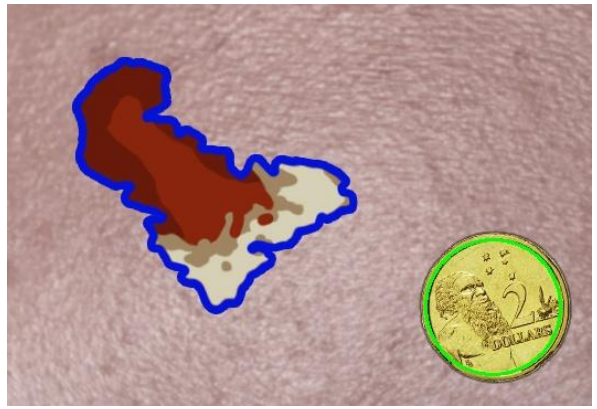
# Colour Analysis

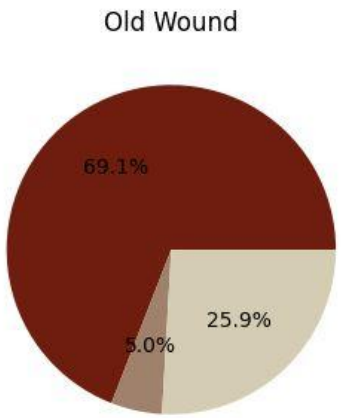
# Colour Analysis

## Sample Wounds

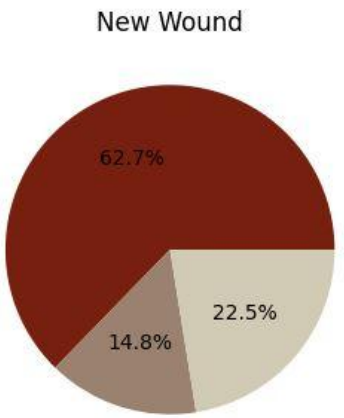
- Appropriate Masking, changes grayscale masks to blue RGB, allowing us to extract black values.
- Extract colour from image to calculate percentage.
- Quantise to reduce colours in image for palette simplification.








Comparison
Granulation: 10.3% -
Slough: 2.5% +
Epithelial: 0.0%
Necrotic (Late): 0.0%
Necrotic (Early): 0.0%



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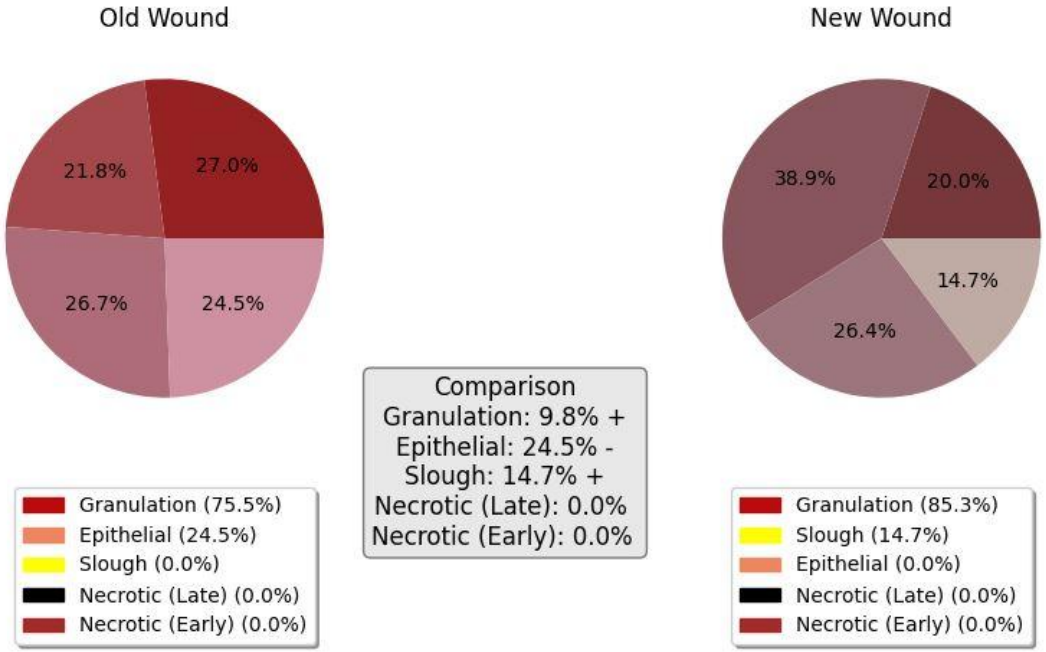
# Colour Analysis

## Ulcer Samples

- Calculate colour similarity using Euclidean distance function.
- Colour Percentages are plotted on a pie chart and comparisons can be made by grouping based on distance.
- Clusters can be tweaked to allow more colours and thresholding can be altered for stricter groupings.



# Thank you for watching!