OPTIMIZING DIABETIC FOOT CARE THROUGH MACHINE LEARNING AND IMAGE PROCESSING

DIABISOLE

my sole my life

2023-170

MEMBERS

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Supervisor
Ms. Jenny Krishara

Co-Supervisor
Ms. Ishara Weerathunga

Extrenal Supervisor
Ms. Piumika De Silva

Group Leader
Ariyasinghe P.A.D.N.I.

Dahanayake U.S.

Samarasinghe S.A.K.S.

Samarakoon S.M.D.H.

Content

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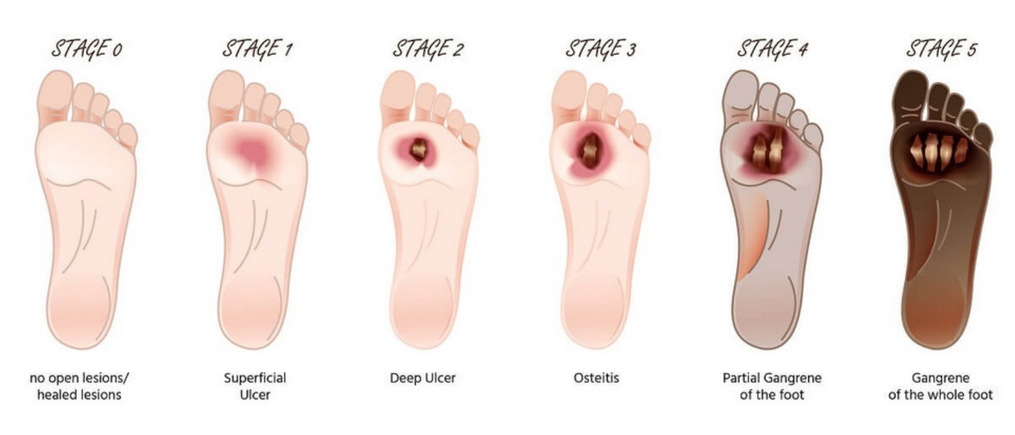
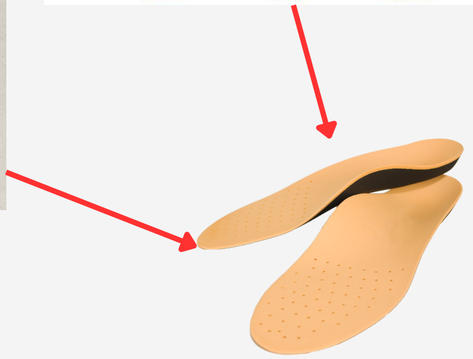
1. INTRODUCTION

- Diabetic Foot Ulcer [DFU] is an open sore or wound that occurs in approximately 15 percent of patients with diabetes.
- Health care professionals commonly use "Wagner's Classification System" to classify DFUs.



- Patients are advised to wear a specialized footwear, also called as "Diabetic Shoes" from the first stage.



Removable Insoles

INTRODUCTION CONT.

Treats/ Operates diabetic patients with foot wounds

Dr. Namaratne treating a patient at **Diabetic Footcare and Rehabilitation Center, Nawala**

Mr. Janaka from **Beta Diabetic Footware Solutions**

Basic Diabetic-Shoe Creation

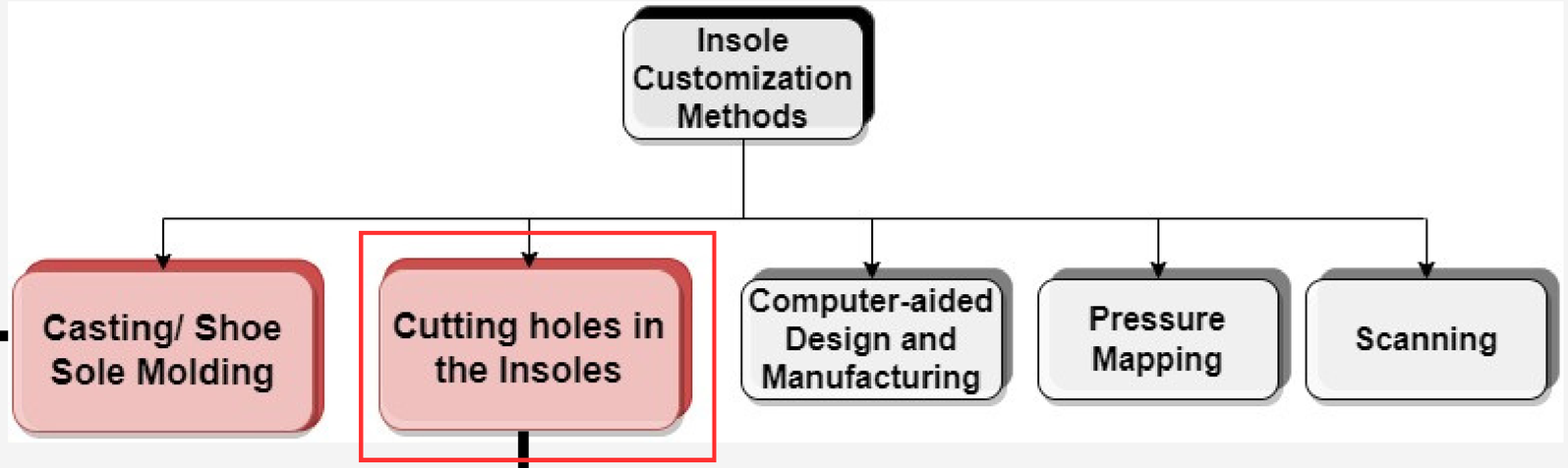
Describing the mold creation at **Ragama Rehabilitation Hospital**

Creation of a customized insole at **Exceed Lanka Pvt Ltd**

Explaining about the Dynamic Scanner at **Kings Hospital**

Diabetic Shoe's Insole Customization

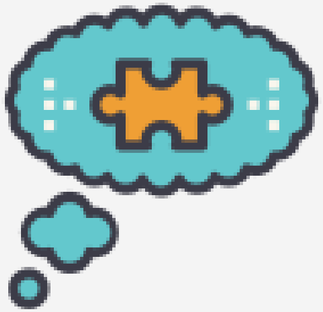
INTRODUCTION CONT.



- Ragama Rehabilitation Hospital
- Exceed Prosthetics and Orthotics Footbalance Lanka Pvt Ltd

- Diabetic Foot and Wound Care Clinic of Kings hospital

2. RESEARCH QUESTION

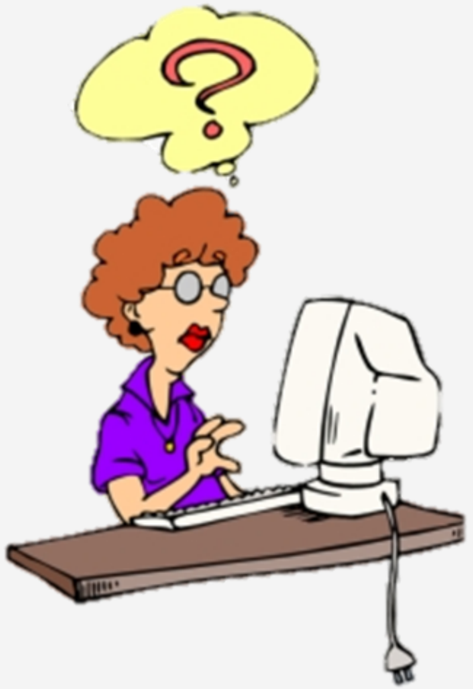


How to Provide Web Application based on Solution to

Cut the holes of the insole in an accurate manner ?

Get the measurements to offload in an automated way ?

Predict DFU criticality?



3. OBJECTIVES

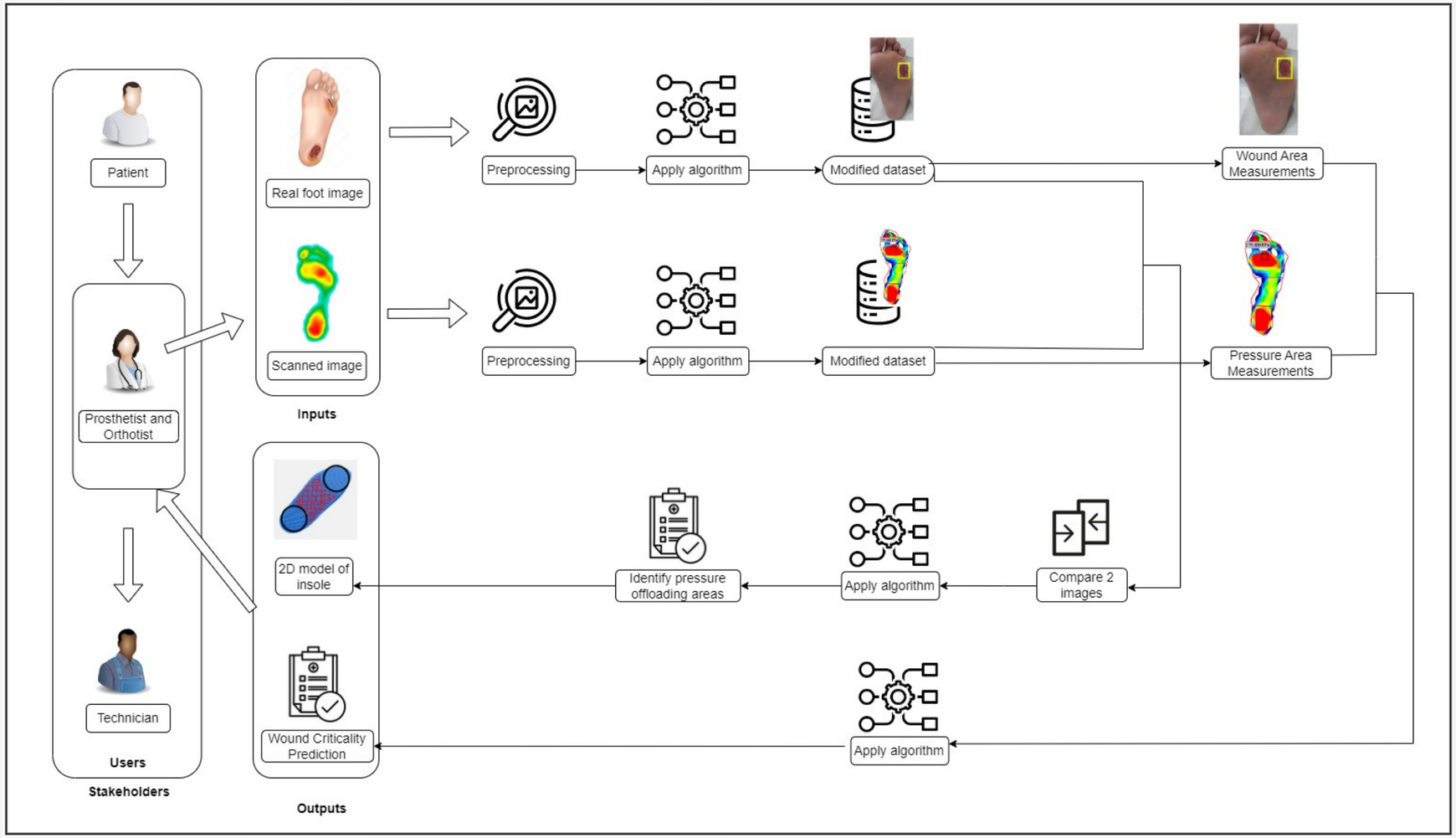
MAIN OBJECTIVE

- Provide web application-based solution to detect and measure the accurate areas to cut holes for offloading the insole and predict wound criticality automatically.

SPECIFIC OBJECTIVES

- Identify wound areas by analysing the real sole images.
- Measure the identified wound areas to get the hole sizes and predict wound criticality.
- Identify and measure high-pressure areas (red colour areas) by using the scanned foot image
- Analyze the two datasets containing images of feet and identify pressure offloading areas

4. System Overview Diagram



5. Technologies

Web Application

- Windows

Database

- MySQL

Backend Technologies

- Python
- TensorFlow

Technical Concepts

- Machine Learning
- Computer Vision
- Image Processing

Algorithms

- U-Net Architecture
- Classification Models
- Optimization Algorithms

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BSc(Hons)Degree in Informatin Technology (specialization in Data Science)

COMPONENT 01

Identify and measure high-pressure areas (red colour areas) by using the scanned foot image

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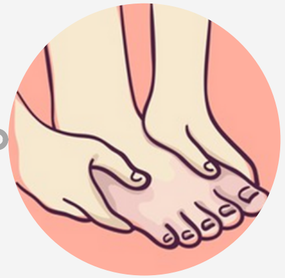
INTRODUCTION

★ BACKGROUND

High Pressure

Blisters or ulcers that do not heal

Redness or discoloration



Swelling of the foot

Calluses or corns

Pain in the foot or toes

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RESEARCH GAP

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Data-driven CAD-CAM vs traditional total contact custom insoles [2]

- Compared the offloading performance of two different types of insoles for patients with diabetic foot
- Discovered that data-driven CAD-CAM technology can be a useful tool for designing and producing custom insoles

Customized Foot Pressure Redistribution Insole Design using Image-based Rapid Pressure Measuring System [3]

- Developed a system that uses rapid pressure measuring and image-based technology to create custom adaptive multi-airbag insoles
- Designed to fit the unique contours of the user's foot and offer personalised support and cushioning in areas where it's most necessary

A Compact Wearable System for Detection of Plantar Pressure for Diabetic Foot Prevention [4]

- The wearable shoe-pads feature pressure sensors that can detect and monitor changes in plantar pressure on the feet

Design of a Smart In-Sole to Model and Control the Pressure Under Diabetic Patients' Feet [5]

- Developed a unique shoe insole that can prevent the formation of foot sores.
- Created an insole that adjusts to reduce pressure and prevent sore formation with excessive pressure.

SYSTEM COMPARISON

Features	01	02	03	04	DiabiSole
High pressure (red color) areas identification	✗	✗	✗	✓	✓
Image processing techniques	✓	✗	✓	✗	✓
Offloading places identification	✗	✗	✓	✗	✓
High pressure (red color) areas measurement	✗	✗	✗	✗	✓

01 - Customized Foot Pressure Redistribution Insole Design using Image-based Rapid Pressure Measuring System [3]

02 - A Compact Wearable System for Detection of Plantar Pressure for Diabetic Foot Prevention [4]

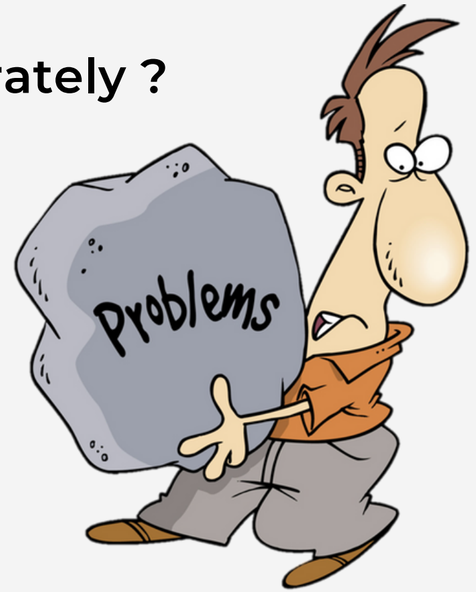
03 - Data-driven CAD-CAM vs traditional total contact custom insoles [2]

04- Design of a Smart In-Sole to Model and Control the Pressure Under Diabetic Patients' Feet [5]

RESEARCH PROBLEM

How to provide web application-based solution to

- Identify high pressure areas automatically ?
- Measure the areas of high -pressure ?
- Provide foot care measurements accurately ?



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OBJECTIVES

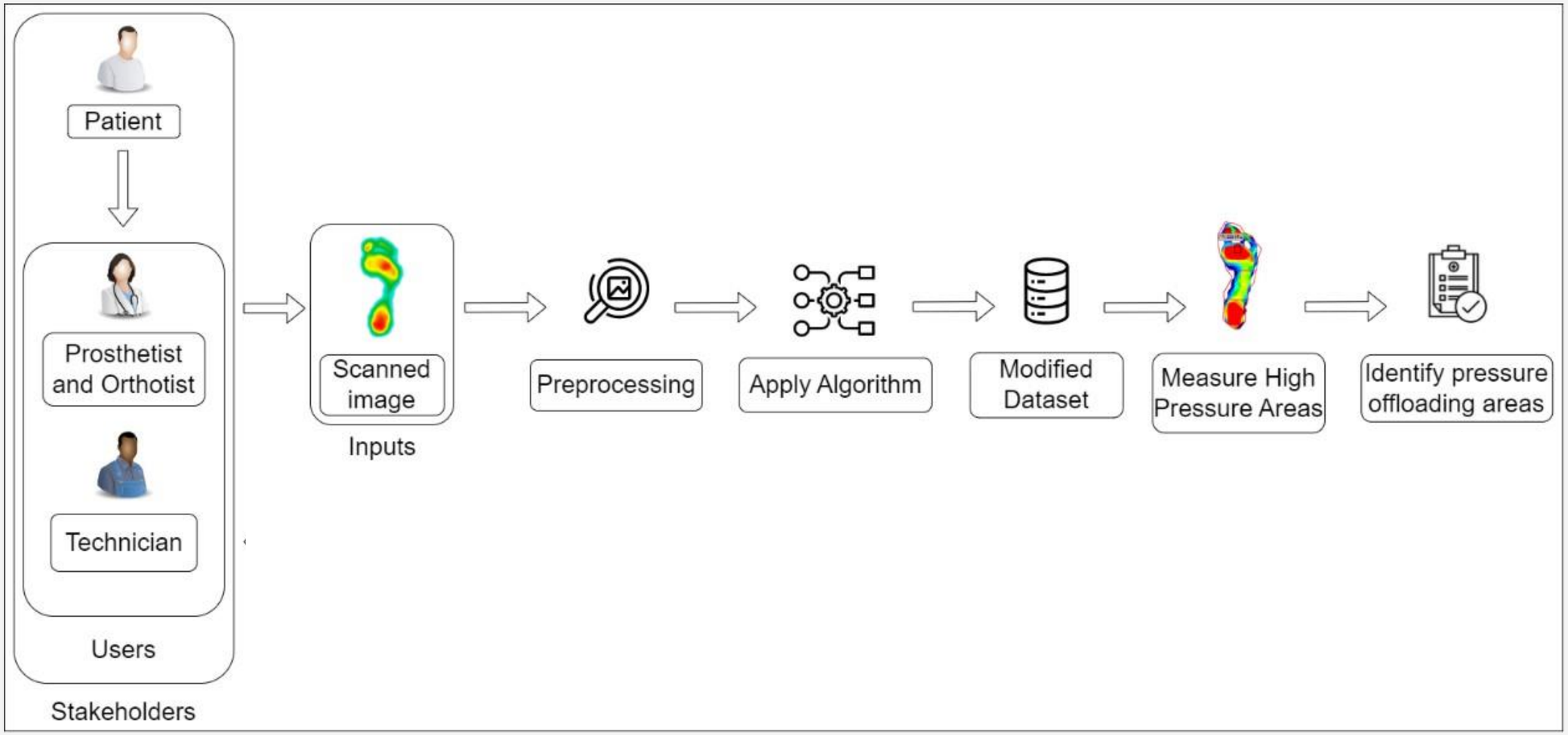
SPECIFIC OBJECTIVE

- Detect high pressure areas and measure the locations of those areas to offload the insole in an accurate manner

Sub Objectives

- Analyze the images to identify the exact areas of high-pressure points.
- Modify the initial image dataset by displaying circles around the detected high-pressure areas.
- Generate a dataset which contains the scanned sole images.
- Determine the precise size of the identified high-pressure areas.

METHODOLOGY



Component Overview Diagram

KEY PILLARS

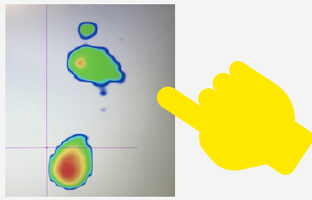
Machine Learning

U-Net architecture

GUI - Tkinter

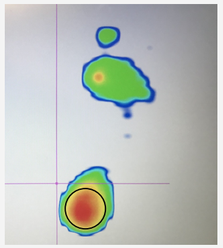
Image Processing and Computer Vision

1. Image Selection



2. High pressure area segmentation

3. Visualisation



4. Measurement

5. API interaction

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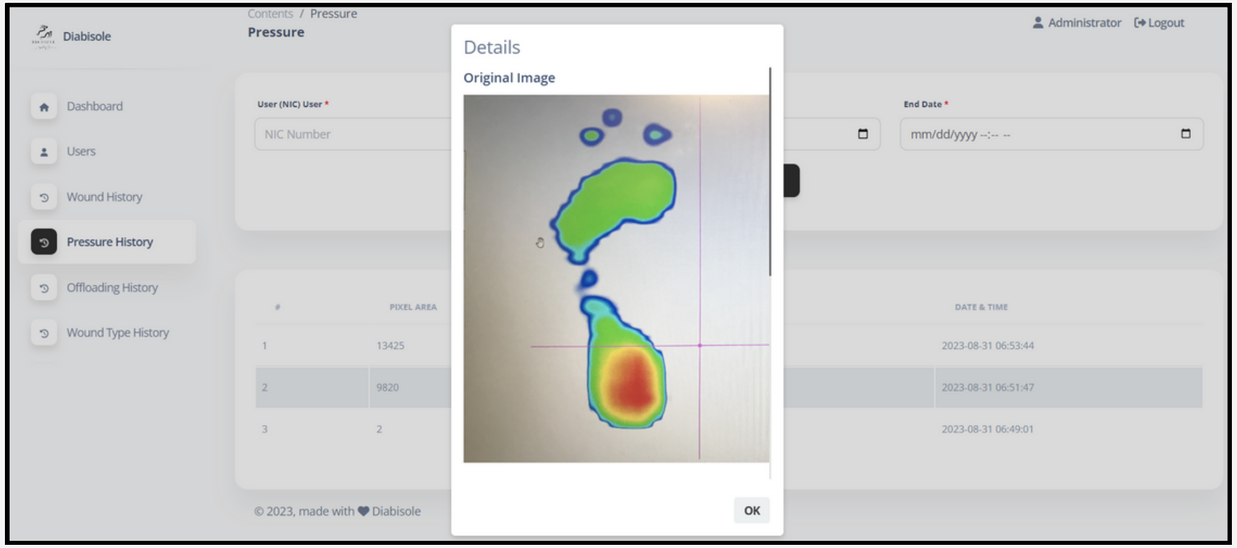
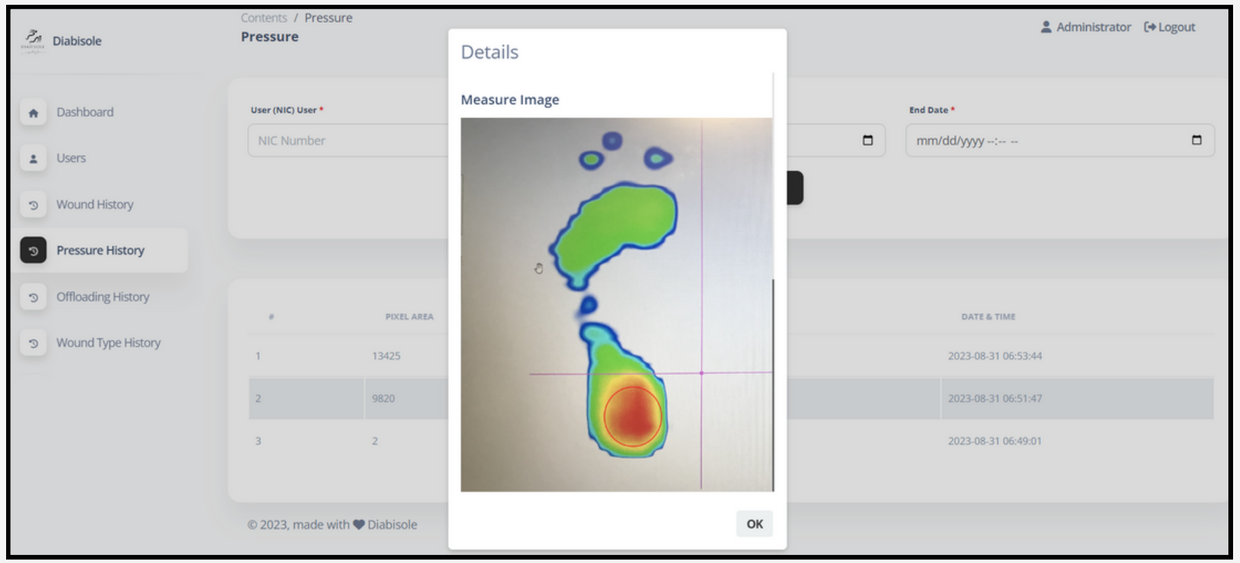
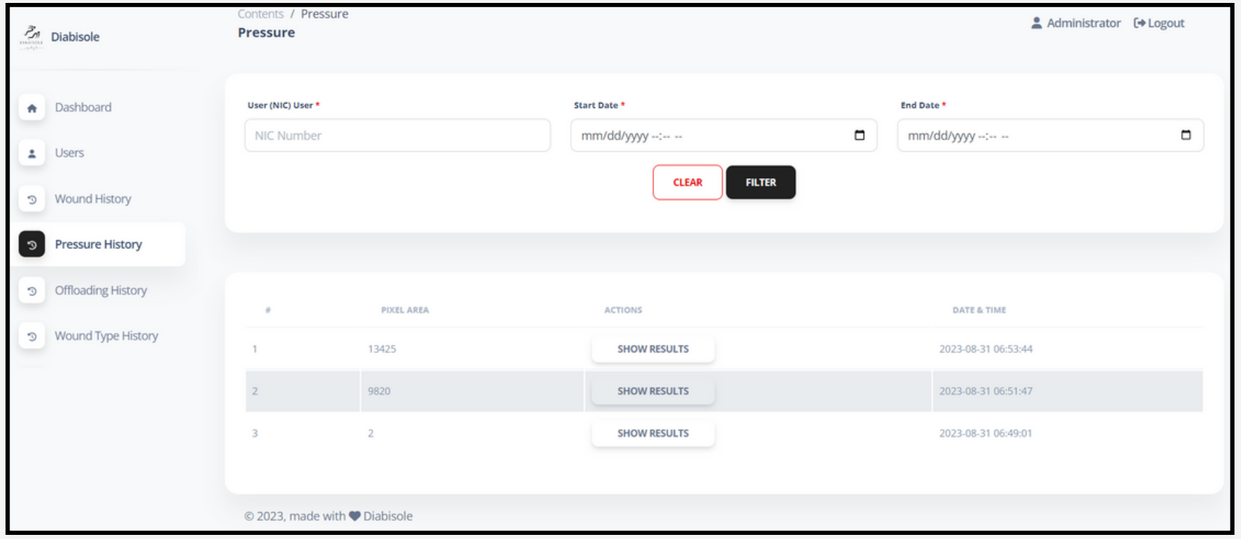
FINAL PRODUCT OUTPUTS



Original image that selected



Original Image with circled high pressure areas



Results with pixel areas

RESULTS AND DISCUSSIONS

Trained U-Net model Accuracy

```
Model: "disease_classification"
__________________________________________________________________________________________________
 Layer (type)                Output Shape              Param #     Connected to
==================================================================================================
 input (InputLayer)          [(None, 256, 256, 3       0           []
                             )]

 conv2d (Conv2D)             (None, 256, 256, 32       896         ['input[0][0]']
                             )

 dropout (Dropout)           (None, 256, 256, 32       0           ['conv2d[0][0]']
                             )

 conv2d_1 (Conv2D)           (None, 256, 256, 32       9248        ['dropout[0][0]']
                             )

 max_pooling2d (MaxPooling2D)  (None, 128, 128, 32     0           ['conv2d_1[0][0]']
                             )

 conv2d_2 (Conv2D)           (None, 128, 128, 64       18496       ['max_pooling2d[0][0]']
                             )

 dropout_1 (Dropout)         (None, 128, 128, 64       0           ['conv2d_2[0][0]']
                             )

...
Epoch 499/500
3/3 [==============================] - 0s 51ms/step - loss: 0.0166 - accuracy: 0.9932 - recall: 0.9932 - precision: 0.9932
Epoch 500/500
3/3 [==============================] - 0s 51ms/step - loss: 0.0132 - accuracy: 0.9944 - recall: 0.9944 - precision: 0.9944
Output is truncated. View as a scrollable element or open in a text editor. Adjust cell output settings...
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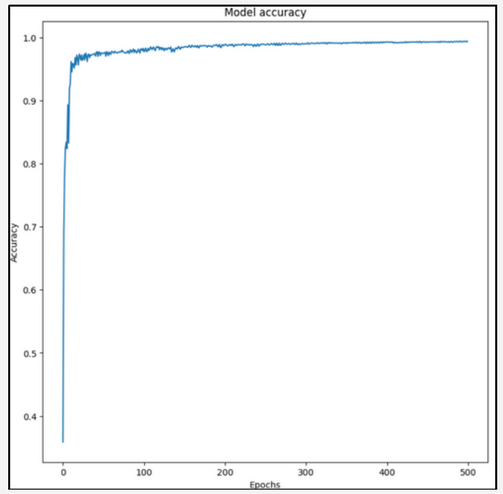
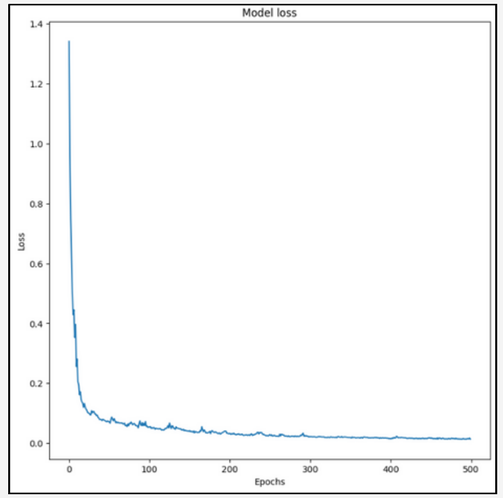
Model Accuracy

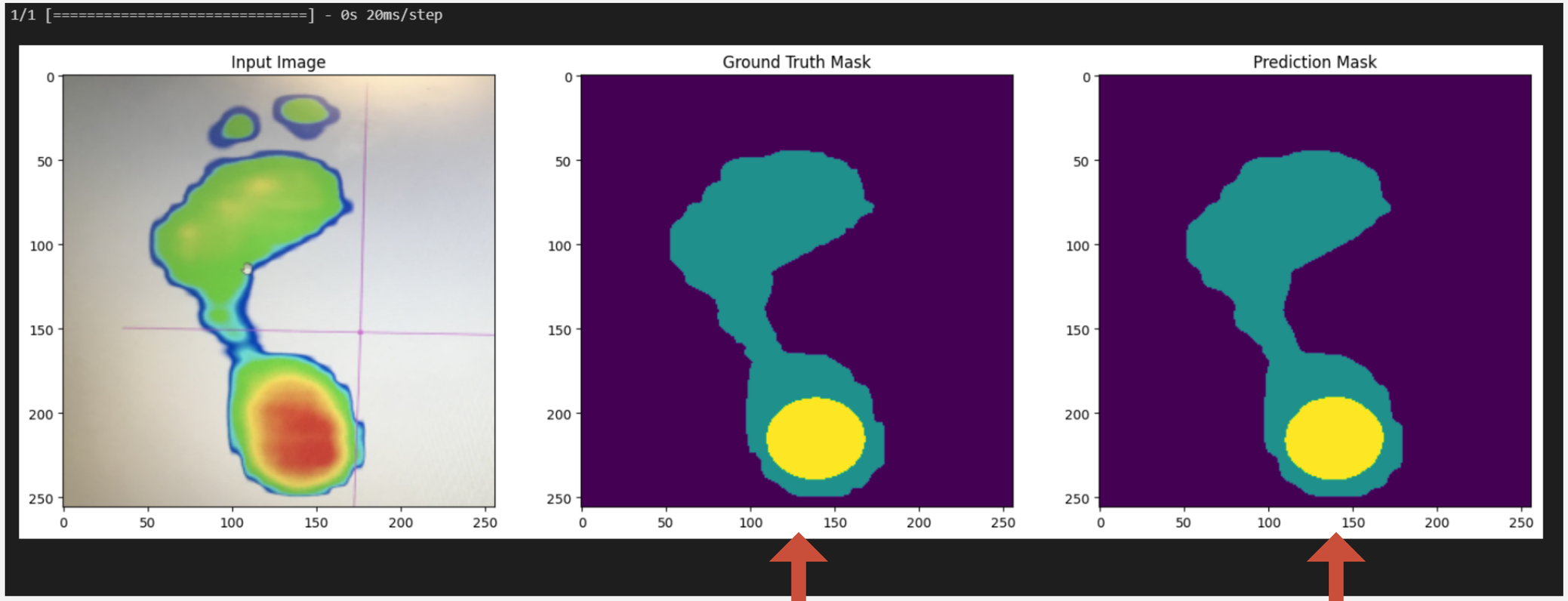


Model Loss



RESULTS AND DISCUSSIONS CONT...

Compare the model's predictions to the ground truth, helping how well the model is performing



manual segmentation

resulting output of the model

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[1] M. A. B. a. S. BOUKHENOUS, "A low Cost Smart Insole for Diabetic Foot Prevention," International Conference on Applied Smart Systems , Medea, Algeria, 2018.

[2] K. E. R. P. G. A. C. C. B. F. M. G. C. D'Amico M, "Data-driven CAD-CAM vs traditional total contact custom insoles: A novel quantitative-statistical framework for the evaluation of insoles offloading performance in diabetic foot," PLoS One, 2021

[3] M. Y. L. a. S. H. W. C. C. Chang, "Customized foot pressure redistribution, Canada: IEEE , 2007.

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[5] A. A. H. A. S. A. E. A.-F. a. L. E. A. Albathi, ""DESIGN OF A SMART IN-SOLE TO MODEl AND CONTROL THE PRESSURE UNDER DIABETIC PATIENTS' FEET,"," International Conference on Modeling Simulation and Applied Optimization (ICMSAO), Manama,Bahrain, 2019.

[6] C. A. C. P. R. R. Y. K. a. S. D. K. Petsarb, ""Low cost and customized plantar pressure analyzer for foot pressure image in rehabilitation foot clinic,"," Biomedical Engineering International Conference, Muang, Thailand, 2012.

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Component 02

Identify wound areas by analyzing the real sole images.

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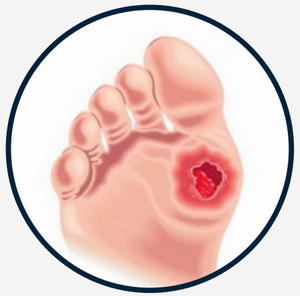
INTRODUCTION

★ BACKGROUND



Diabetic Foot Ulcer

Generally caused by minor injuries or pressure.

Identified through visual observations and physical examination.

Visible signs such as redness, swelling, discharge, or odor.

Typically occur in ball of the foot, the bottom of the big toe, and the heel.

RESEARCH GAP

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Robust Methods for Detecting and Localizing Diabetic Foot Ulcers in Real Time on Mobile Devices [1]

- Proposed a system for real-time detection and localization of DFU.
- Use Faster R-CNN with InceptionV2 model.

A New Mobile Application for Standardizing Diabetic Foot Images [2]

- Proposed a system to standardize photographs of diabetic feet.
- Useful to monitor the progress of DFUs.

Deep Learning Methods for Real-time Detection and Analysis of Wagner Ulcer Classification System [3]

- A system for classifying and locating DFU based on the severity of the ulcer.
- Assist podiatrists in diagnosing DFU in order to reduce workload and provide patients with timely and relevant information.

Fully Convolutional Networks for Diabetic Foot Ulcer Segmentation [4]

- System for detecting and segmenting DFUs and surrounding skin.
- Propose a two-tier transfer learning model to train FCNs.

SYSTEM COMPARISON

Features	01	02	03	04	DiabiSole
Wound location identification.	✓	✗	✓	✓	✓
Display indications around identified wound areas.	✓	✗	✗	✗	✓
New dataset generation	✗	✗	✗	✗	✓
Image processing techniques.	✓	✓	✓	✓	✓

01 - Robust Methods for Detecting and Localizing Diabetic Foot Ulcers in Real Time on Mobile Devices

02 - A New Mobile Application for Standardizing Diabetic Foot Images

03 - Deep Learning Methods for Real-time Detection and Analysis of Wagner Ulcer Classification System

04- Fully Convolutional Networks for Diabetic Foot Ulcer Segmentation

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RESEARCH PROBLEM

How to provide web application-based solution to

- Accurately identify wound locations ?
- Modify the dataset with indications around identified wound locations?

OBJECTIVES

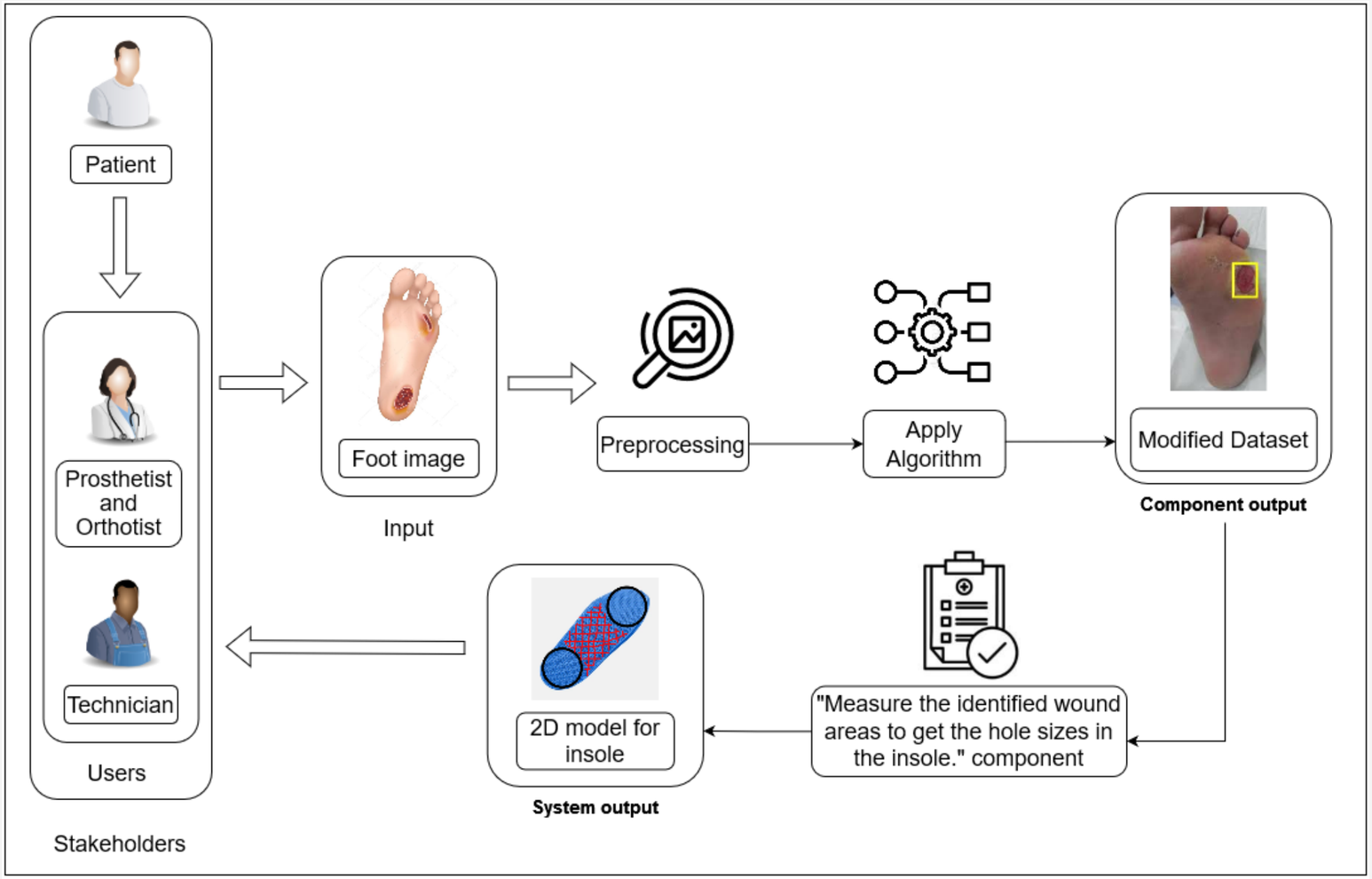
SPECIFIC OBJECTIVE

- Accurately identify wound locations by analyzing sole images of patients with DFU.

Sub Objectives

- Analyze the sole images to identify wound locations accurately.
- Generate a dataset with identified wound locations highlighted.

METHODOLOGY



Component Overview Diagram

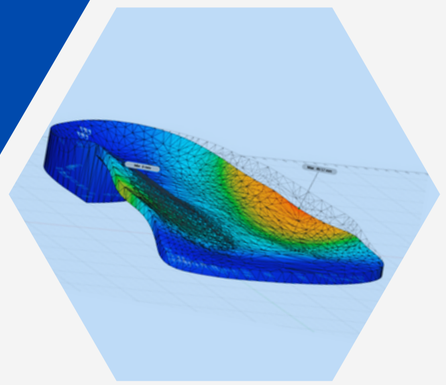
KEY PILLARS

Machine Learning

U-net Architecture

Computer Vision

Semantic Segmentation



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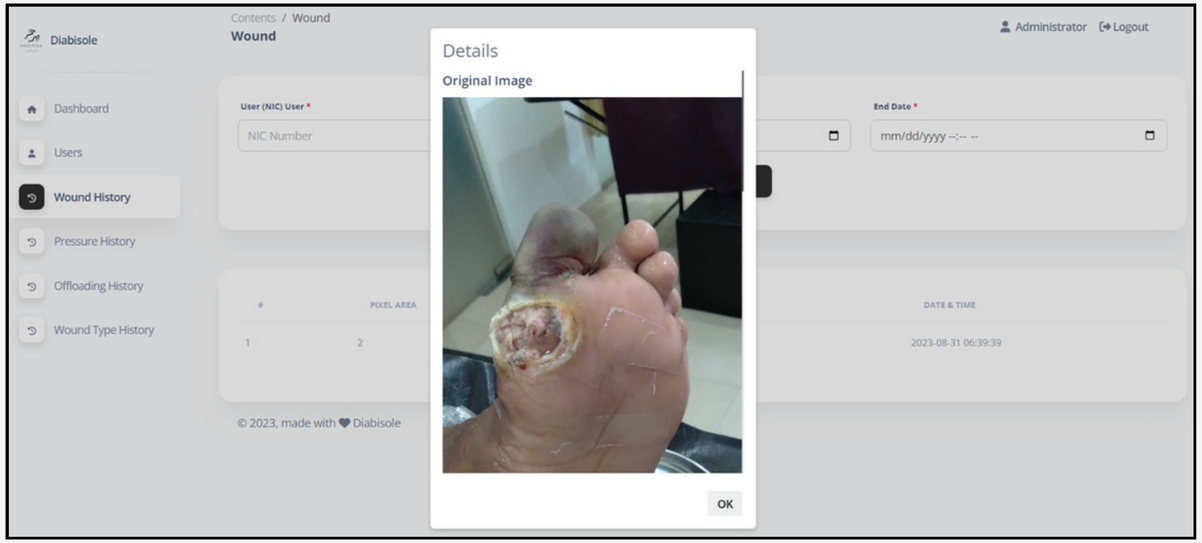
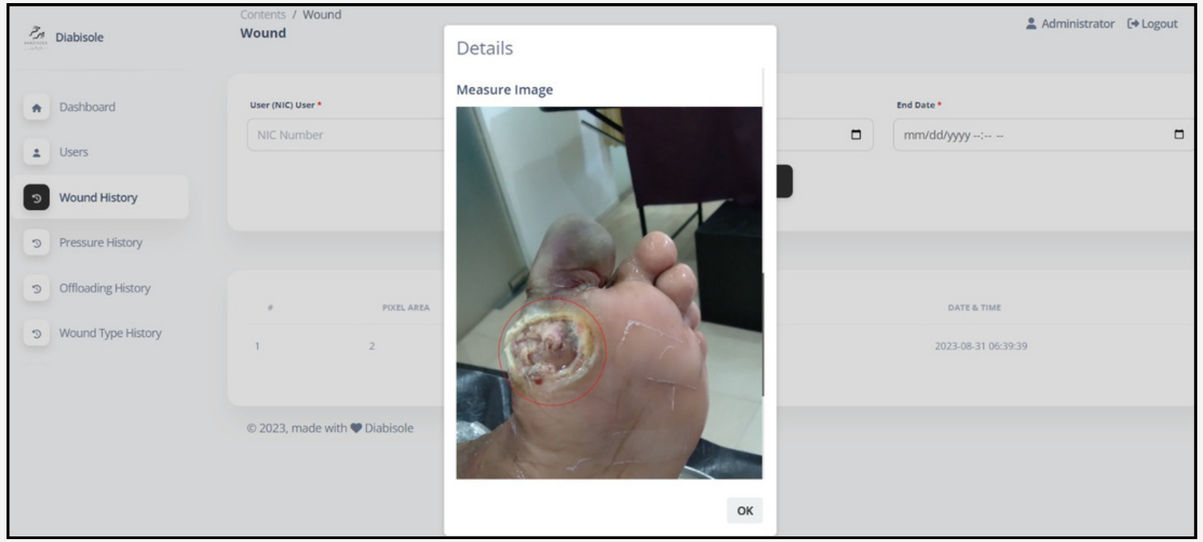
FINAL PRODUCT OUTPUTS



Uploaded foot image



Foot image with circled wound areas

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RESULTS AND DISCUSSION

```
Model: "wound_classification"
_________________________________________________________________________________________________
 Layer (type)                Output Shape              Param #     Connected to
=================================================================================================
 input (InputLayer)          [(None, 256, 256, 3       0           []
                             )]

 conv2d (Conv2D)             (None, 256, 256, 32       896         ['input[0][0]']
                             )

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                             )

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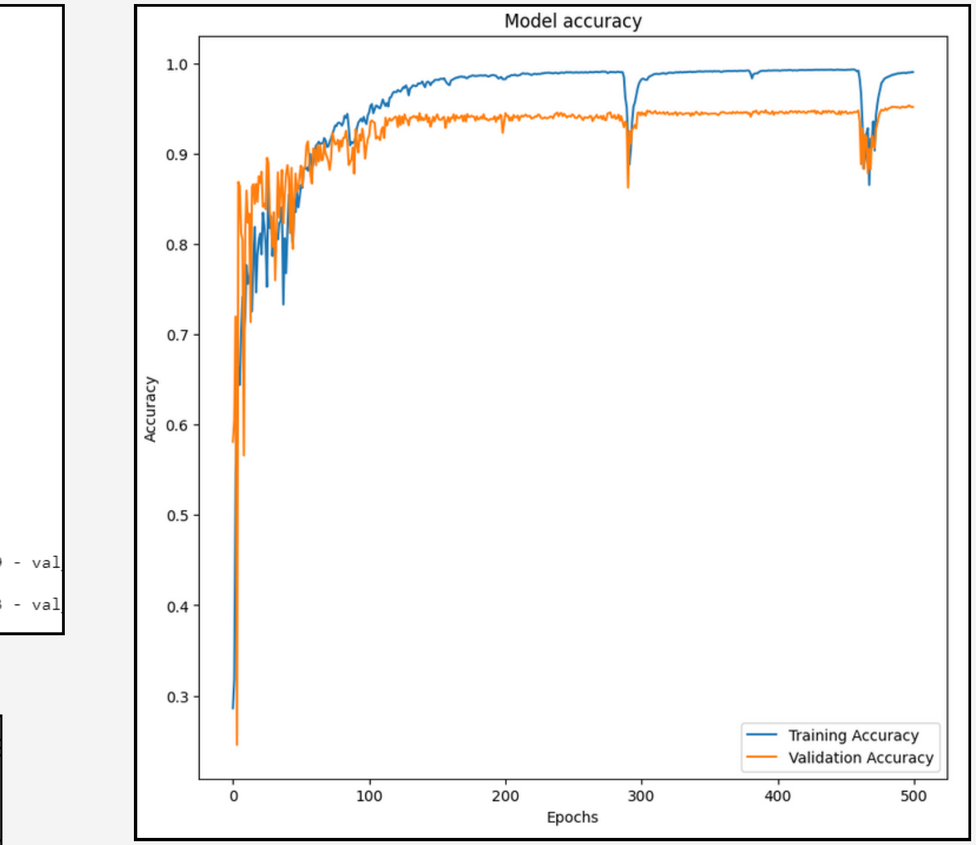
                             )

 conv2d_2 (Conv2D)           (None, 128, 128, 64       18496       ['max_pooling2d[0][0]']
                             )

 dropout_1 (Dropout)         (None, 128, 128, 64       0           ['conv2d_2[0][0]']
                             )

...
12/12 [==============================] - 34s 3s/step - loss: 0.0209 - accuracy: 0.9901 - recall: 0.9900 - precision: 0.9903 - val_loss: 0.2879 - val
Epoch 500/500
12/12 [==============================] - 35s 3s/step - loss: 0.0213 - accuracy: 0.9902 - recall: 0.9901 - precision: 0.9904 - val_loss: 0.2903 - val
Final Validation Accuracy: 95.17%
```




```
12/12 [==============================] - 34s 3s/step - loss
Epoch 500/500
12/12 [==============================] - 35s 3s/step - loss
Final Validation Accuracy: 95.17%
```

U-net model accuracy

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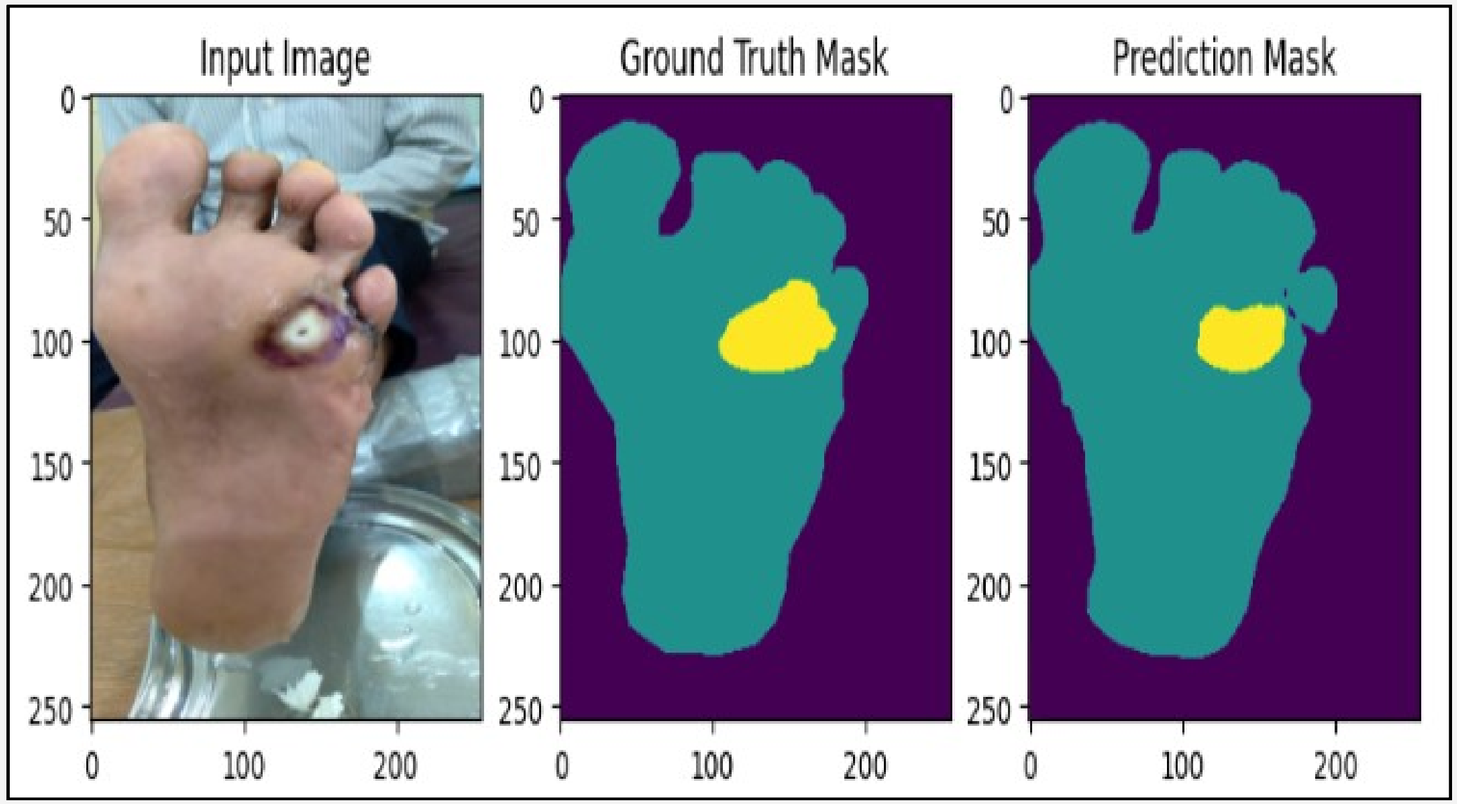
RESULTS AND DISCUSSION



Input image, Ground truth and Prediction mask

Output with circled wound area

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REFERENCES

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IT20033828 | Ariyasinghe P.A.D.N.I.

BSc (Hons) Degree in Information Technology (specialization in Data Science)

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Component 03

Measure the identified wound areas to get the hole sizes and Wound criticality prediction.

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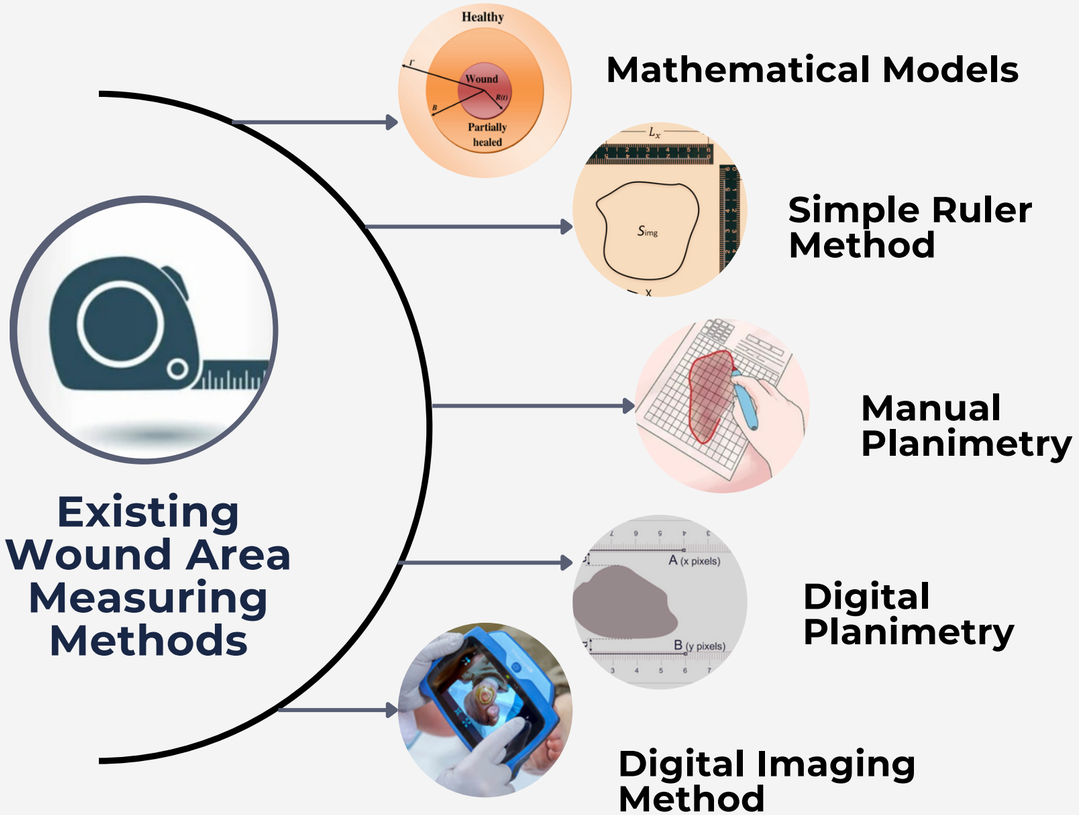
INTRODUCTION

★ BACKGROUND



Existing Wound Assessment Methods

- Wound Criticality Scoring Models
- Wound Classification Models
- Self-assessment Questionnaires

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RESEARCH GAP

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The UTrack framework for segmenting and measuring dermatological ulcers through telemedicine [1]

- Designed to take pictures, outline relevant regions, and visualize analysis results in a fast, portable, and straightforward manner.
- A tick marker detection method, which combined with image segmentation, used to approximate the wound area.

Experimental Study on Wound Area Measurement with Mobile Devices [2]

- Develop a method for accurate wound measurement with desktop and mobile devices.
- Used Image Processing techniques. Used Counters and Threshold with Segmentation to detect wounds and Open CV framework to measure the area.
- Features: Contour information, Wound shape, Wound color

A new diabetic foot risk assessment tool: DIAFORA [3]

- Predict ulcer onset - Features: Neuropathy, Foot deformity, Arteriopathy, Previous diabetic foot ulcer or lower extremity amputation
- Uses a point system to stratify groups of risk. There has been no external validation nor reliability assessment.

Diabetic neuropathic foot ulcers: predicting which ones will not heal [4]

- Features - Wound area, Duration, Curative Health Services (CHS) wound classification system grade.
- Was externally validated only once. No reliability assessment has been published.

SYSTEM COMPARISON

Features	01	02	03	04	DiabiSole
Identification of Diabetic Ulcer on foot	✓	✓	✗	✗	✓
Image processing techniques	✗	✓	✗	✗	✓
Measure Callus/ Ulcer size	✓	✓	✗	✗	✓
Assess Callus criticality	✗	✗	✓	✓	✓
Use both wound area and high-pressure area for criticality prediction.	✗	✗	✗	✗	✓

01 - The UTrack framework for segmenting and measuring dermatological ulcers through telemedicine [1]

02 - Experimental Study on Wound Area Measurement with Mobile Devices [2]

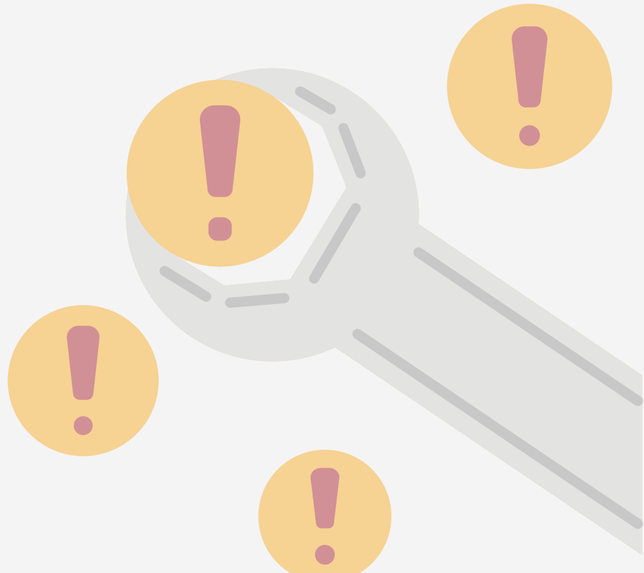
03 - A new diabetic foot risk assessment tool: DIAFORA [3]

04- Diabetic neuropathic foot ulcers: predicting which ones will not heal [4]

RESEARCH PROBLEM

How to provide web application-based solution to

- Measure wound (callus) areas automatically ?
- Accurately predict the criticality of calluses?



OBJECTIVES

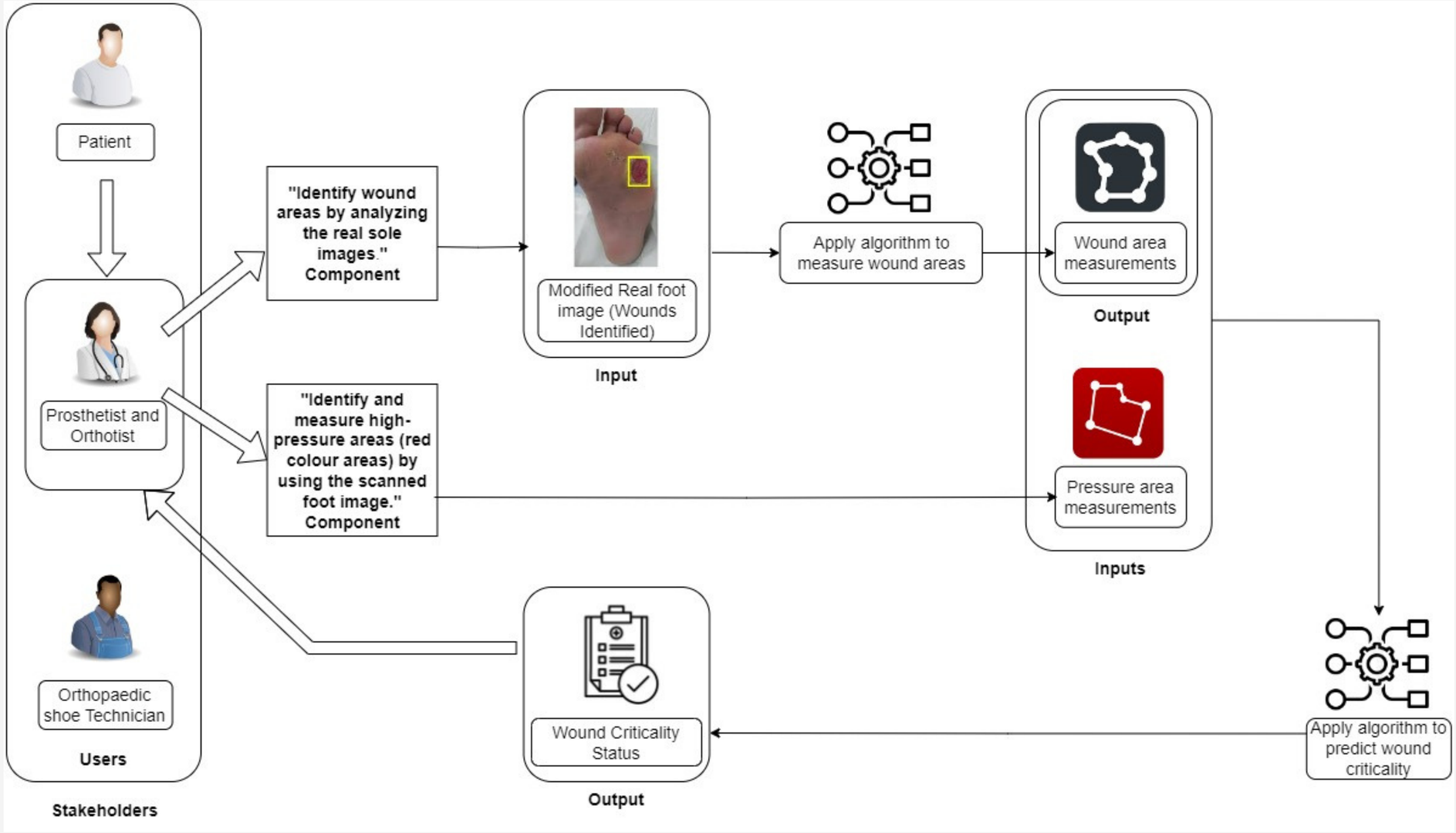
SPECIFIC OBJECTIVES

- Measure the identified wound areas to get the hole sizes and Predict wound criticality.

Sub Objectives

- Measure the size of the identified callus area.
- Predict the criticality of calluses (severe, not severe).
- Keep track of patients' wound measurements and callus criticality.

METHODOLOGY



Component Overview Diagram

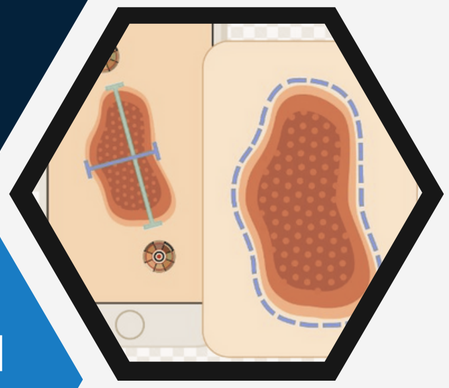
KEY PILLARS

DIABISOLE
my sole my life

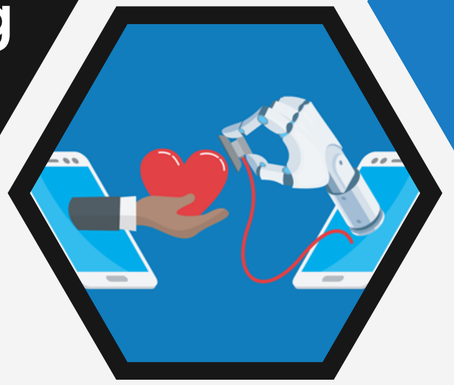
Machine Learning

Image Processing

Python GUI - Tinker



Supervised Learning



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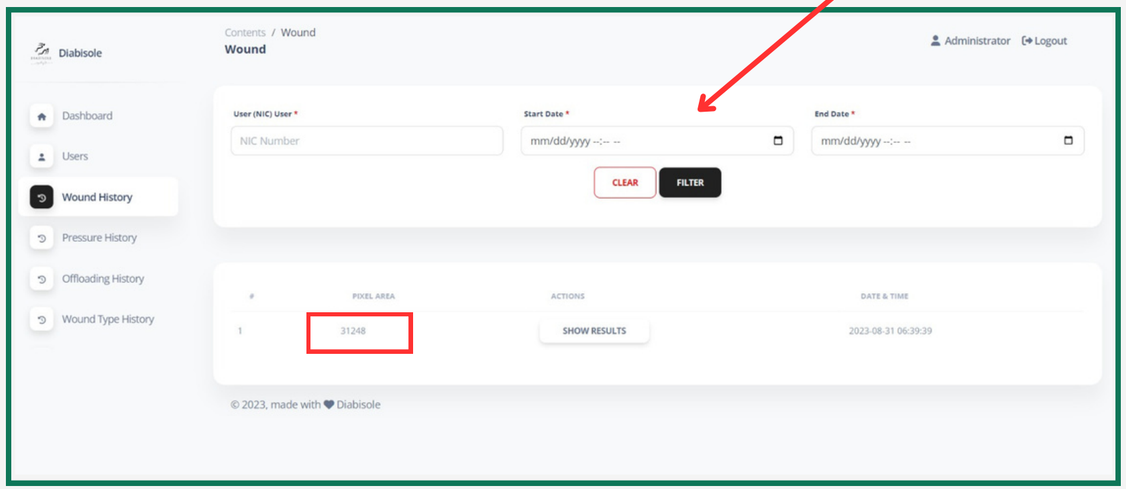
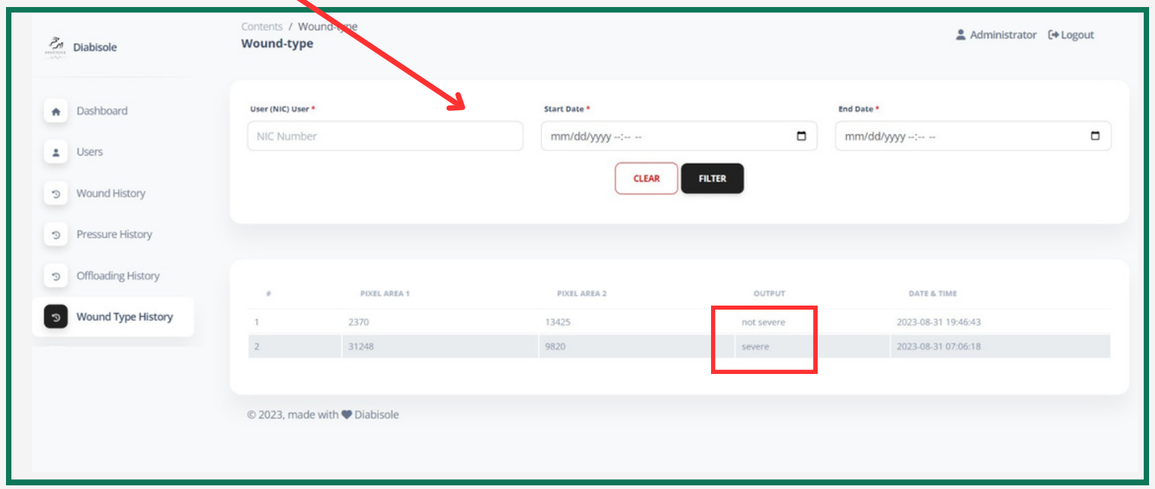
FINAL PRODUCT OUTPUTS

Filter Patients



Wound Area Measurements



Wound Criticality Prediction

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RESULTS AND DISCUSSIONS - Wound Area Measurements

Wound Area Identified Image

Wound Area Measurement

	A	B
1	Image	Wound Area (pixel
2	100.jpg	58089
3	10.jpg	18823
4	1.jpg	6379
5	102.jpg	84070.
6	101.jpg	212256.
7	103.jpg	520573.
8	105.jpg	22981
9	104.jpg	509562

```python
import csv

# Path to the wound area annotation file
ground_truth_file = '/content/drive/My Drive/original_measurements.csv'

# Read the wound area annotations
ground_truth = {}
with open(ground_truth_file, 'r') as file:
    reader = csv.reader(file)
    next(reader)  # Skip the header row
    for row in reader:
        image_name = row[0]
        wound_area = float(row[1])
        ground_truth[image_name] = wound_area

# Calculate accuracy
correct_measurements = 0
total_measurements = len(measurements)

for measurement in measurements:
    image_name = measurement[0]
    area = measurement[1]
    if image_name in ground_truth:
        ground_truth_area = ground_truth[image_name]
        if abs(area - ground_truth_area) <= 10:  # Define a threshold for ac
            correct_measurements += 1

accuracy = (correct_measurements / total_measurements) * 100

print("Accuracy:", accuracy, "%")
```

```
Accuracy: 97.14285714285714 %
```

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RESULTS AND DISCUSSIONS - Wound Criticality Prediction

Trained ML Models

- Decision Tree - Accuracy: 98.95%
- Random Forest - Accuracy: 98.95%
- Gaussian Naive Bayes - Accuracy: 99.21%
- KNN Classifier - Accuracy: 99.21%

Accuracy of Naive Bayes Model

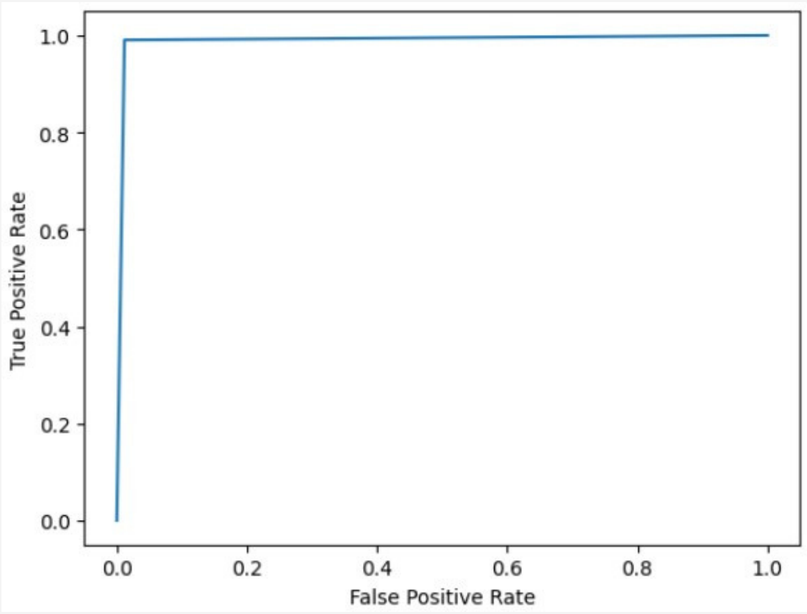
```
print("Accuracy:",metrics.accuracy_score(y_test, y_pred2))
✓ 0.0s
Accuracy: 0.9921259842519685
```

Naive Bayes Classification Report

	precision	recall	f1-score	support
0	0.98	0.99	0.99	171
1	1.00	0.99	0.99	210
accuracy			0.99	381
macro avg	0.99	0.99	0.99	381
weighted avg	0.99	0.99	0.99	381

```
[[170   1]
 [  3 207]]
```

ROC_Area Under Curve_Score: 0.9893



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REFERENCES

[1] M. T. Cazzolato, J. S. Ramos, L. S. Rodrigues, L. C. Scabora, D. Y. T. Chino, A. E. S. Jorge, P. M. de Azevedo-Marques, C. Traina, and A. J. M. Traina, “The UTRACK framework for segmenting and measuring dermatological ulcers through telemedicine,” Computers in Biology and Medicine, 13-May-2021. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S0010482521002833.

[2] F. Ferreira et al., “Experimental Study on Wound Area Measurement with Mobile Devices,” Sensors, vol. 21, no. 17, p. 5762, Aug. 2021, doi: 10.3390/s21175762.

[3] Monteiro-Soares M, Dinis-Ribeiro M. A new diabetic foot risk assessment tool: DIAFORA. Diabetes Metab Res Rev. 2016;32(4): 429-435.

[4] Margolis DJ, Allen-Taylor L, Hoffstad O, Berlin JA. Diabetic neuropathic foot ulcers: predicting which ones will not heal. Am J Med. 2003 Dec 1;115(8):627-31. doi: 10.1016/j.amjmed.2003.06.006. PMID: 14656615.

[5] Jørgensen LB, Sørensen JA, Jemec GB, Yderstraede KB. Methods to assess area and volume of wounds - a systematic review. Int Wound J. 2016 Aug;13(4):540-53. doi: 10.1111/iwj.12472. Epub 2015 Aug 6. PMID: 26250714; PMCID: PMC7949796.

[6] P. Foltynski, A. Ciechanowska, and P. Ladyzynski, “Wound surface area measurement methods,” Biocybernetics and Biomedical Engineering, 06-May-2021. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S0208521621000498. [Accessed: 26-Mar-2023].

DIABISOLE
my safe my life

IT20457952 | Samarakoon S.M.D.H.

BSc(Hons)Degree in Informatin Technology (specialization in Data Science)

COMPONENT 04

DIABISOLE
my sole my life

Analyze the two datasets containing images of feet and identify pressure offloading areas.

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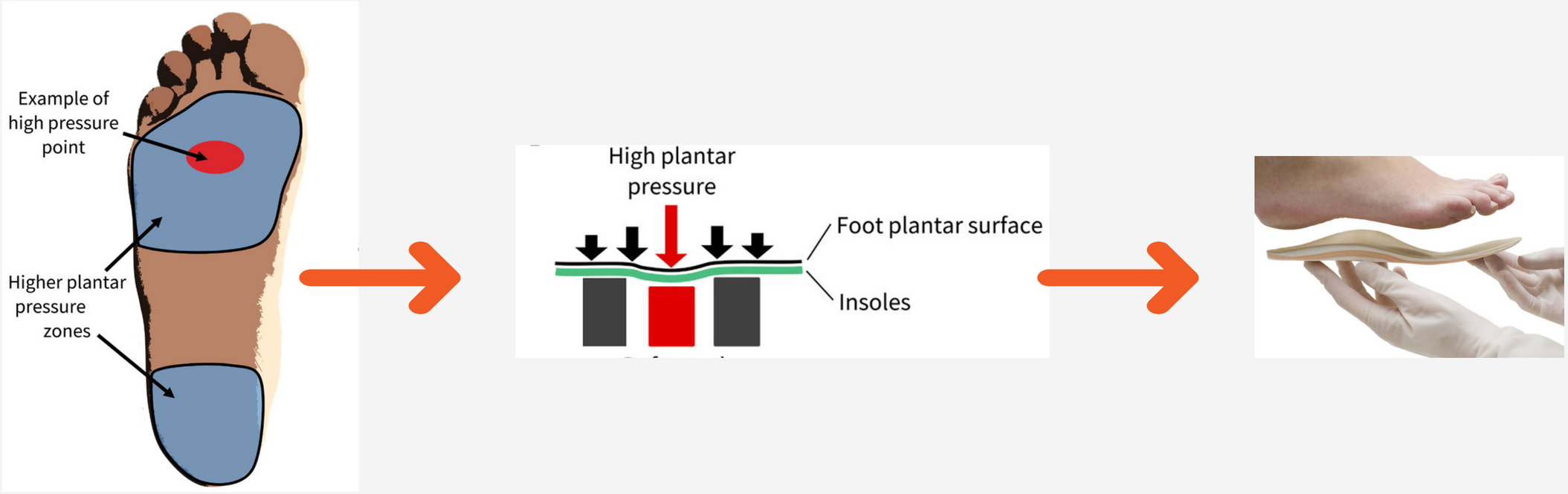
INTRODUCTION

★ BACKGROUND

INTRODUCTION

★ OFFLOADING

Process of redistributing pressure away from specific areas of the foot that are at high risk of developing ulcers or wounds in individuals with diabetes.



RESEARCH GAP

Comparing 3D foot scanning with conventional measurement methods

- Comparing the precision and accuracy of the 3D foot scanning method with conventional foot dimension measurement methods.

Pressure injury image analysis with machine learning techniques.

- Imaging techniques for pressure inquiries and wound assesment.

Footwear and insole design features that reduce neuropathic plantar forefoot ulcer risk in people with diabetes

- Identify the best footwear and insole design features for offloading the plantar surface of the foot.

Effects of Custom-Made Insole Materials on Frictional Stress and Contact Pressure in Diabetic Foot with Neuropathy.

- Custom-made insole (CMI) materials play an important role in plantar pressure reduction.
- Finite element analysis (FEA) can provide an efficient evaluation of different insoles on the plantar pressure distribution.

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SYSTEM COMPARISON

Features	01	02	03	04	DiabiSole
Comparing real foot images and scanned foot images.	✗	✓	✗	✓	✓
Image processing techniques.	✗	✗	✗	✗	✓
Identification of Offloading places.	✗	✗	✓	✗	✓
Customizing the insole.	✗	✗	✗	✗	✓
Visualize the pressure offloading area.	✓	✗	✓	✗	✓

01 -Comparing 3D foot scanning with Conventional Measurement methods. [3]

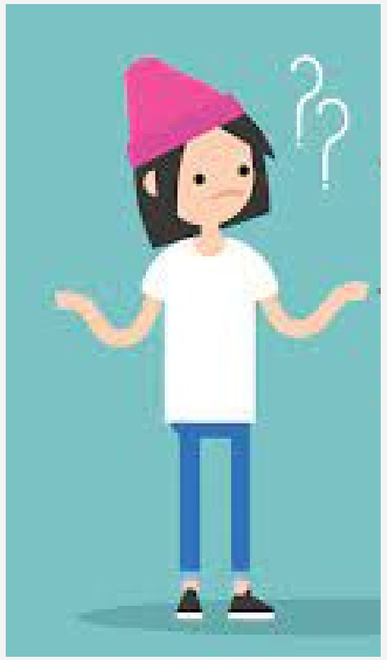
02 - Techniques for Fusion of Multimodal Images: Application to Breast Imaging. [4]

03- Footwear and insole design features for offloading the diabetic at risk foot-A systematic review and meta-analyses [3]

04 - Effects of Custom-Made Insole Materials on Frictional Stress and Contact Pressure in Diabetic Foot with Neuropathy: Results from a Finite Element Analysis.y [2]

RESEARCH PROBLEM

How to provide
web application based
solution to



1. How to identify offloading areas accurately?
2. How to offload high pressure areas automatically?
3. How to output accurately identified offloading areas?
4. How to Calculate offloading areas using pixels?

OBJECTIVES

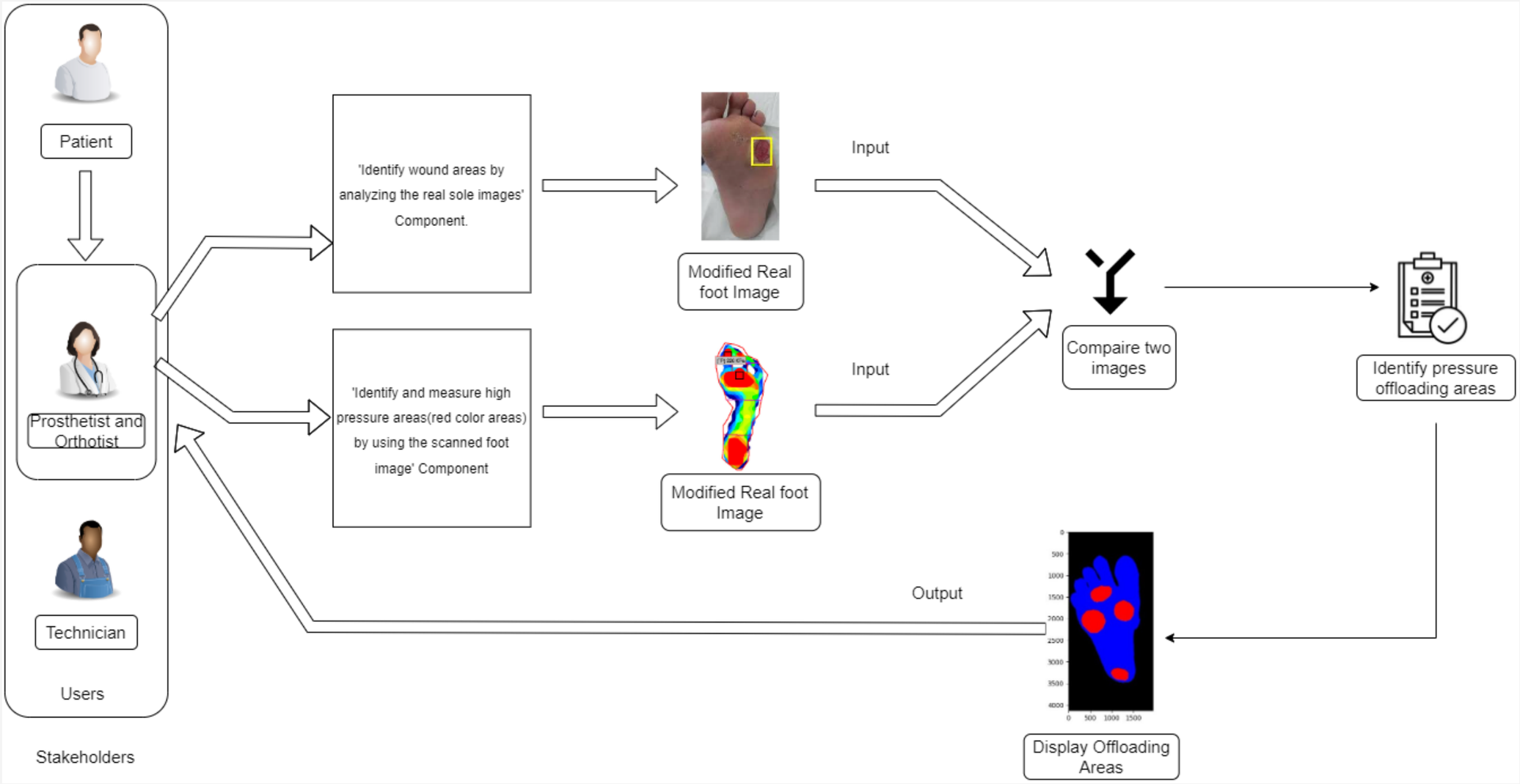
SPECIFIC OBJECTIVE

- Analyze the two datasets containing images of feet, with one showing modified images with circled wounds and the other showing scanned images with circled high-pressure areas. The goal is to identify pressure offloading areas.

Sub Objectives

- Compare the modified images of the real foot and the scanned foot.
- Identify new areas to relieve pressure on high-pressure and wound areas and represent it.
- Displaying precisely identified offloading regions.
- Identify offloading area using pixels.

METHODOLOGY



Component Overview Diagram

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KEY PILLARS

Image Processing

TensorFlow

OpenCV

Pixel distribution analysis

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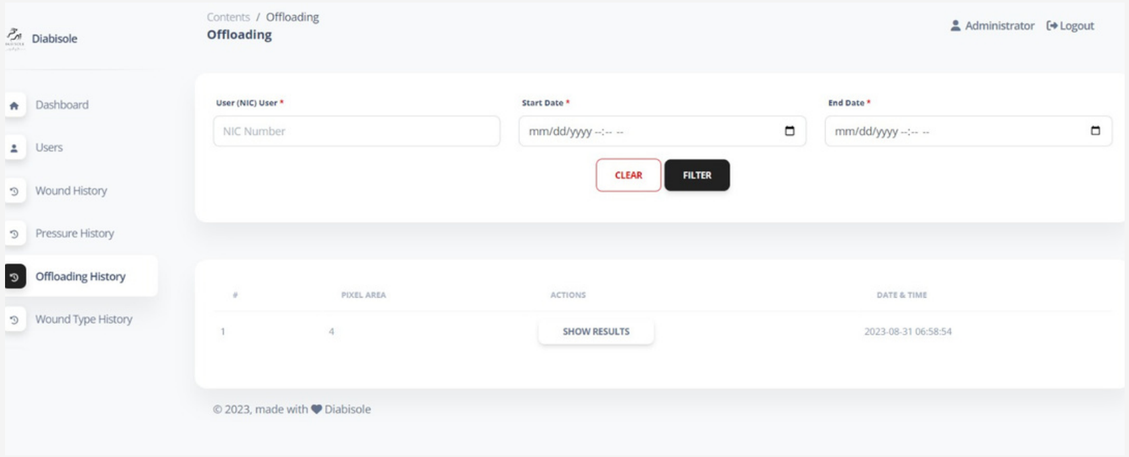
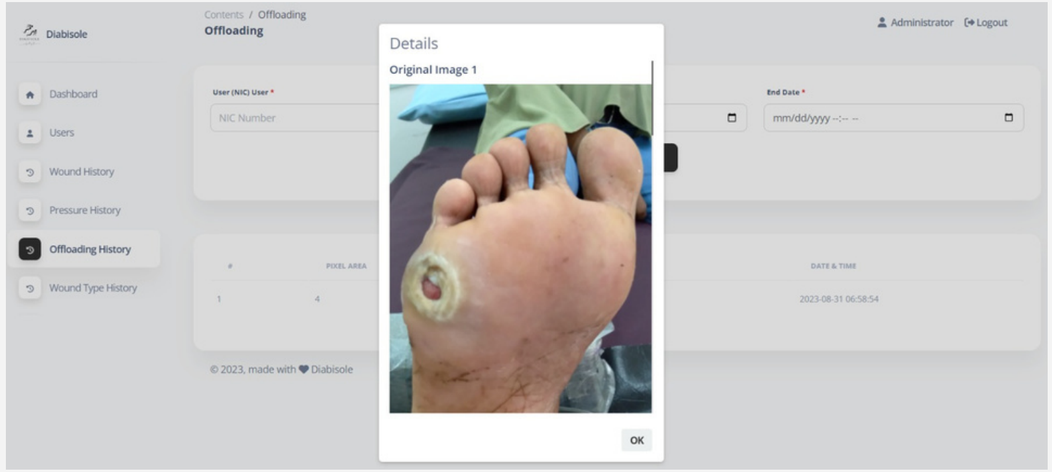
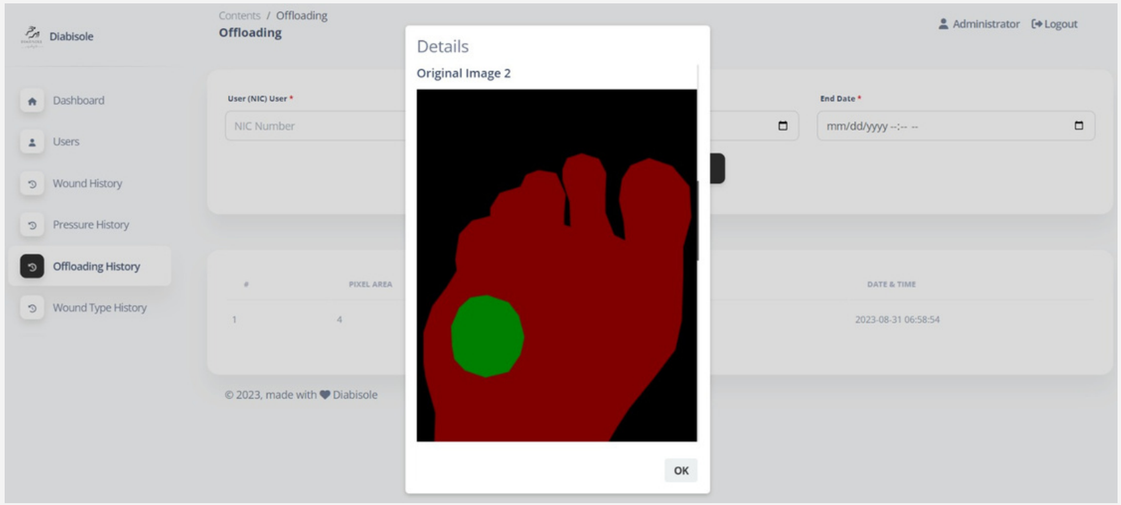
FINAL PRODUCT OUTPUTS



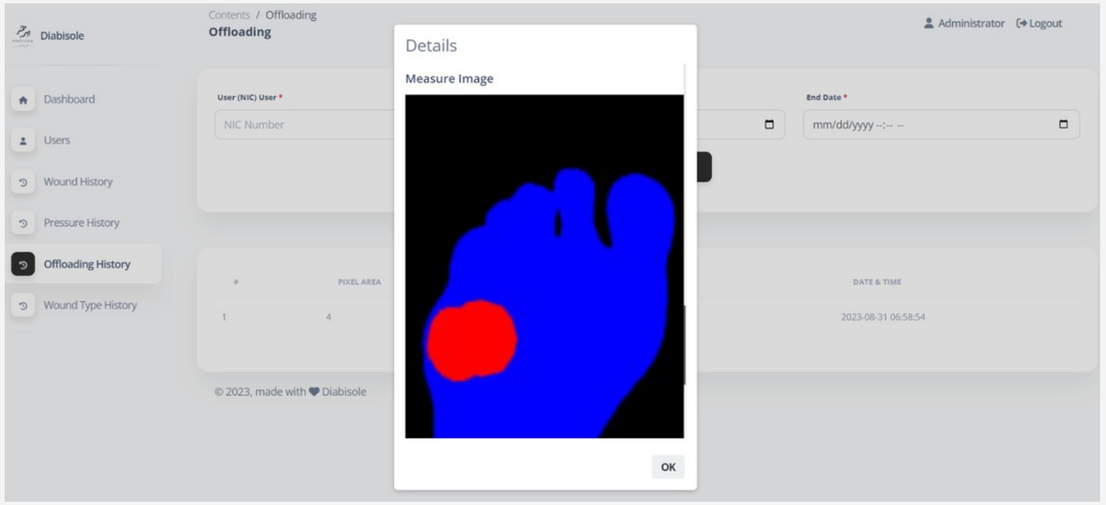
Offloading area mesurement History



Original image that selected.



Presure image that which input.



Offloading representing image.

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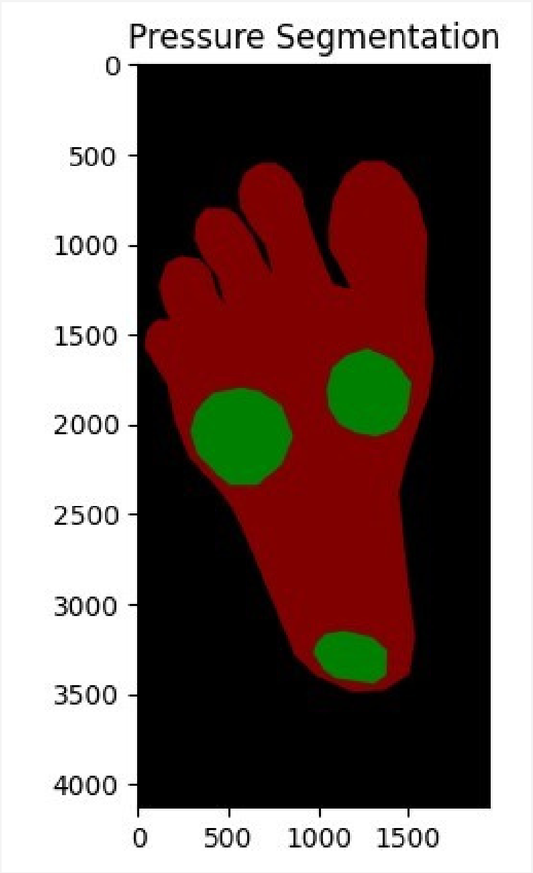
RESULTS AND DISCUSSIONS

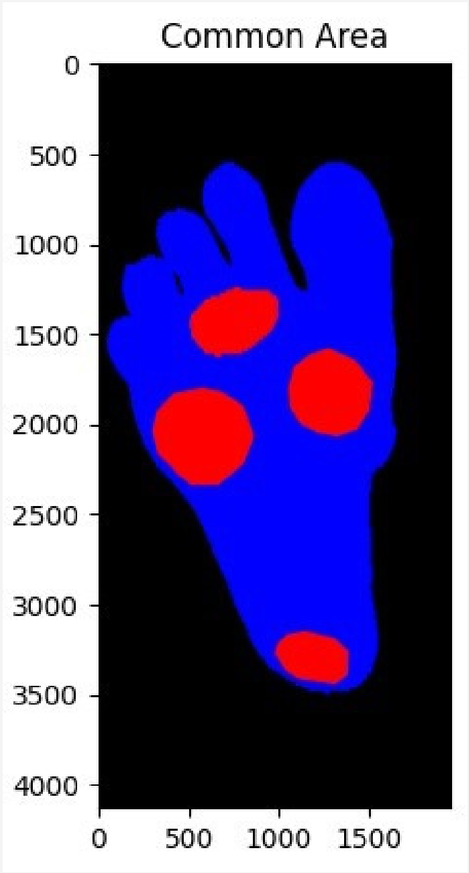
Input

Real Foot Image



Input

Pressure Foot Image



Output

Offloading areas

```
'blue_pixcel_count': 2892240}
```

Output

Offloading area in pixels

REFERENCES

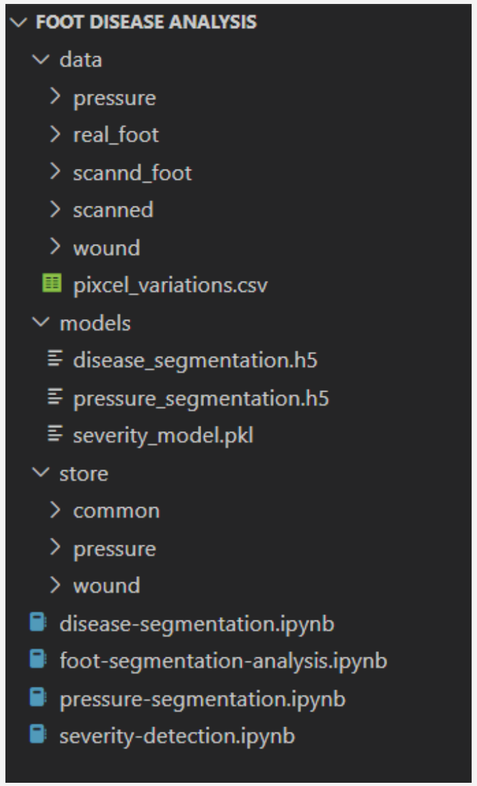
[1] Lee YC, Lin G, Wang MJ. Comparing 3D foot scanning with conventional measurement methods. J Foot Ankle Res. 2014 Oct 25;7(1):44. doi: 10.1186/s13047-014-0044-7. PMID: 25364389; PMCID: PMC4215017.

[2] Lazzarini PA, Jarl G, Gooday C, Viswanathan V, Caravaggi CF, Armstrong DG, Bus SA. Effectiveness of offloading interventions to heal foot ulcers in persons with diabetes: a systematic review. Diabetes Metab Res Rev. 2020 Mar;36 Suppl 1(Suppl 1):e3275. doi: 10.1002/dmrr.3275. PMID: 32176438; PMCID: PMC8370012.

[3] Collings R, Freeman J, Latour JM, Paton J. Footwear and insole design features for offloading the diabetic at risk foot-A systematic review and meta-analyses. Endocrinol Diabetes Metab. 2020 Apr 11;4(1):e00132. doi: 10.1002/edm2.132. PMID: 33532602; PMCID: PMC7831212.

[4] S. Zahia , M. B. G. Zapirain, X. Sevillano, A. González , P. J. Kim , and A. Elmaghraby, “Pressure Injury Image Analysis with Machine Learning Techniques: A systematic review on previous and possible future methods,” Artificial Intelligence in Medicine, 13-Nov-2019. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0933365718307127. [Accessed: 26-Mar-2023].

7. STANDARDS AND BEST PRACTICES

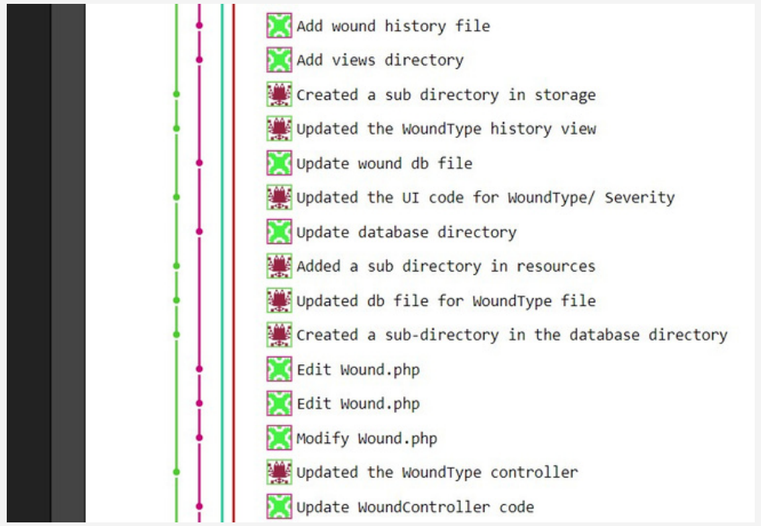


Component organization

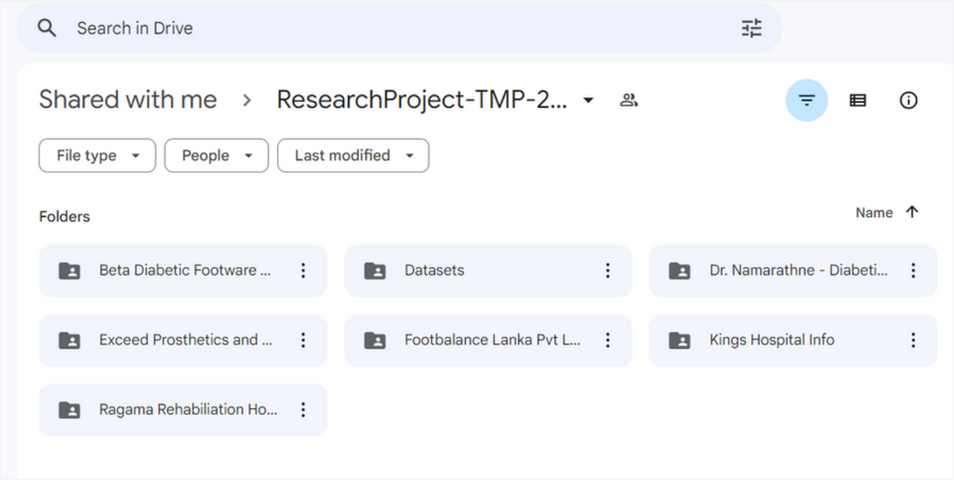
```python
#assembling a dataset for training a machine learning model
def prepare_dataset():
    images = glob(image_dir+"*.jpg")
    inputs, outputs, original_inputs = [], [], []
    for image_path in images:
        image_path = image_path.replace('\\', '/')
        mask_path = image_path.replace('/image/', '/black/').replace('.JPG', '.png')

        if os.path.exists(mask_path) and os.path.exists(image_path):
            input_ = preprocess_input(image_path)[0]
            label_ = preprocess_output(mask_path)
            inputs.append(input_)
            outputs.append(label_)

    inputs = np.asarray(inputs)
    outputs = np.asarray(outputs)

    inputs_np = np.zeros((inputs.shape[0], inputs.shape[1], inputs.shape[2], inputs.sh
    outputs_np = np.zeros((outputs.shape[0], output_shape_new[0], output_shape_new[1])

    for i in range(inputs.shape[0]):
        inputs_np[i] = inputs[i]
        outputs_np[i] = outputs[i]

    return inputs_np, outputs_np
#this function reads image and mask files, preprocesses them, and assembles a dataset
```

0.0s

Increase code readability using developer comments and proper indentation



Descriptive Source Control in GitLab



Maintaining separate secure private drive folder to maintain data

8. REQUIREMENTS

DIABISOLE
my sole my life

Personal Requirements

- Doctors
- Technician
- Patient
- Medical officer

System Requirements

Software

User-end

- Windows

Developer-end

- Visual Studio Code
- Python v3.7
- MySql
- Tinker

Hardware

- Camera
- Dynamic Foot Scanner
- Desktop/ Laptop

Non-functional Requirements

- Performance
- Reliability
- Scalability
- Usability
- Maintainability
- Security

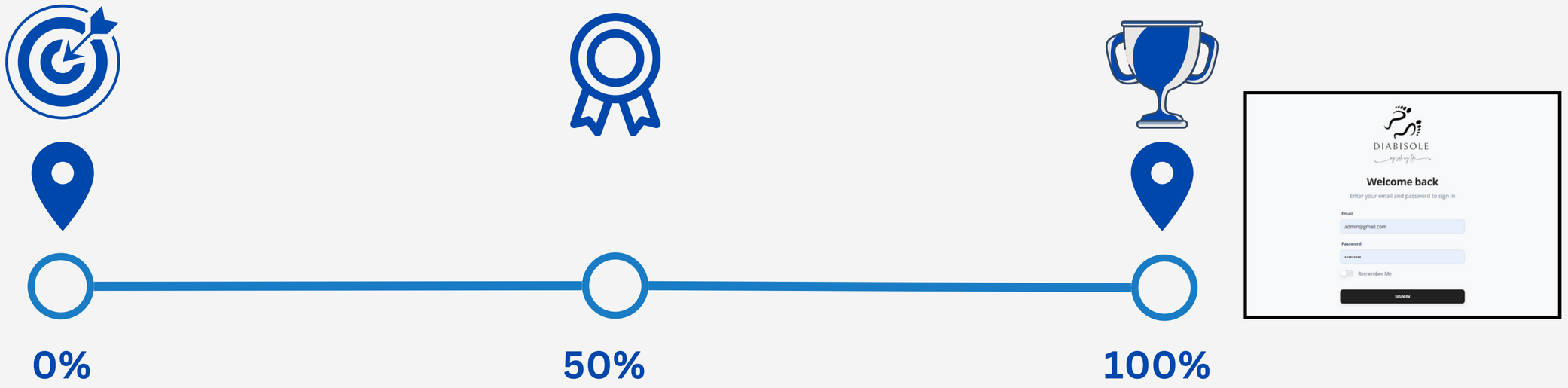
9. PROFESSIONAL, LEGAL, SOCIAL, SECURITY AND ETHICAL ISSUES

Restriction in data collection due to the sensitive medical data.

Lack of resource persons related to the domain.

Lack of data from foot pressure scanners.

10. ADDRESSING THE FUNCTIONAL REQUIREMENT IN IMPLEMENTATION

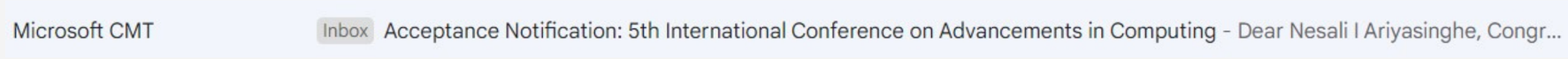


For the currently completed component implementation, all the functional requirements have been addressed which we had previously mentioned on the proposal presentation.

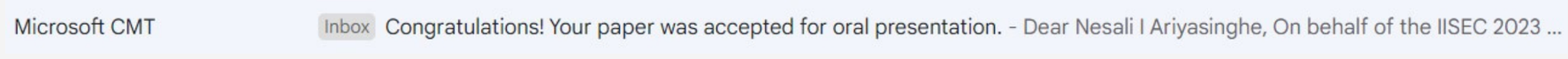
11. RESEARCH PUBLICATION

- We have got acceptance from two conferences for our research paper.

1. 5th International Conference on Advancements in Computing (ICAC) 2023 -> H-Index = 11



2. 4TH International Informatics and Software Engineering Conference (IISEC) 2023 -> H-Index = 13



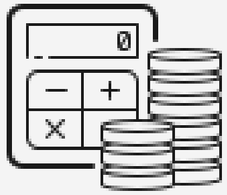
12. COMMERCIALIZATION ASPECTS

Using the proposed application, we hope to provide annual subscription plans considering each side.

Non Affordable Hospitals
Free of Charge

Prosthetic and Orthotic Surgeons.
Monthly Subscription 15,000 /=

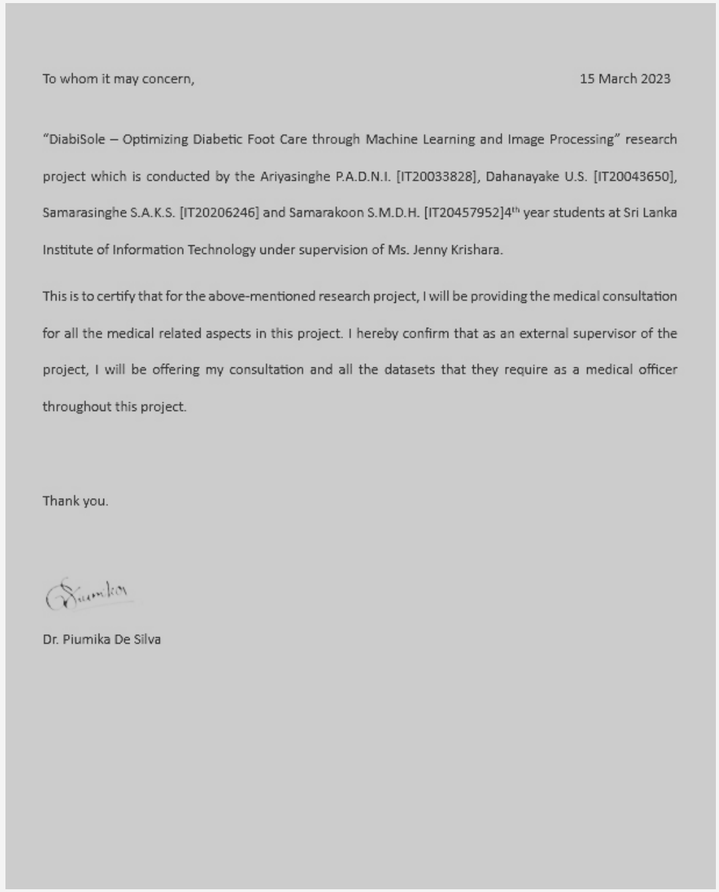
Kings Hospital.
Free of Charge



13. BUGET

Component	Amount (LKR)
Travelling fee for the data gathering	2500.00
Internet charges (the development and technical information learning)	3000.00
Stationary	2000.00
Total	7500.00

APPENDIX



To whom it may concern, 15 March 2023

"DiabiSole – Optimizing Diabetic Foot Care through Machine Learning and Image Processing" research project which is conducted by the Ariyasinghe P.A.D.N.I. [IT20033828], Dahanayake U.S. [IT20043650], Samarasinghe S.A.K.S. [IT20206246] and Samarakoon S.M.D.H. [IT20457952]4th year students at Sri Lanka Institute of Information Technology under supervision of Ms. Jenny Krishara.

This is to certify that for the above-mentioned research project, I will be providing the medical consultation for all the medical related aspects in this project. I hereby confirm that as an external supervisor of the project, I will be offering my consultation and all the datasets that they require as a medical officer throughout this project.

Thank you.

Dr. Piumika De Silva

Letter from External Supervisor

TESTING

DIABISOLE
my sole my life

To whom it may concern,

I have personally gone through the web application DIABISOLE: Optimizing Diabetic Foot Care Through Machine Learning and Image Processing which is implemented by the students Ariyasinghe P.A.D.N.I., Dahanayake U.S., Samarasinghe S.A.K.S. and Samarakoon S.M.D.H can recommend this web application for podiatrists who are responsible in Diabetic foot care with customizing insoles.

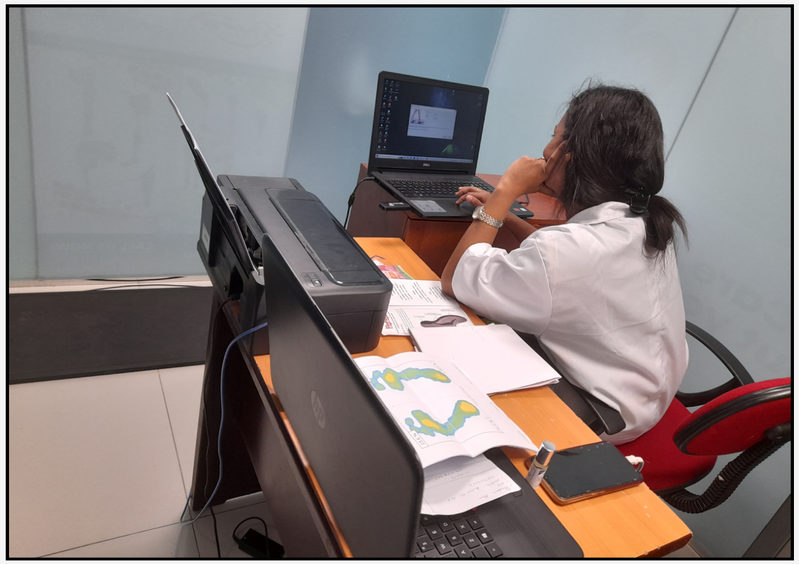
Thank you.

.....

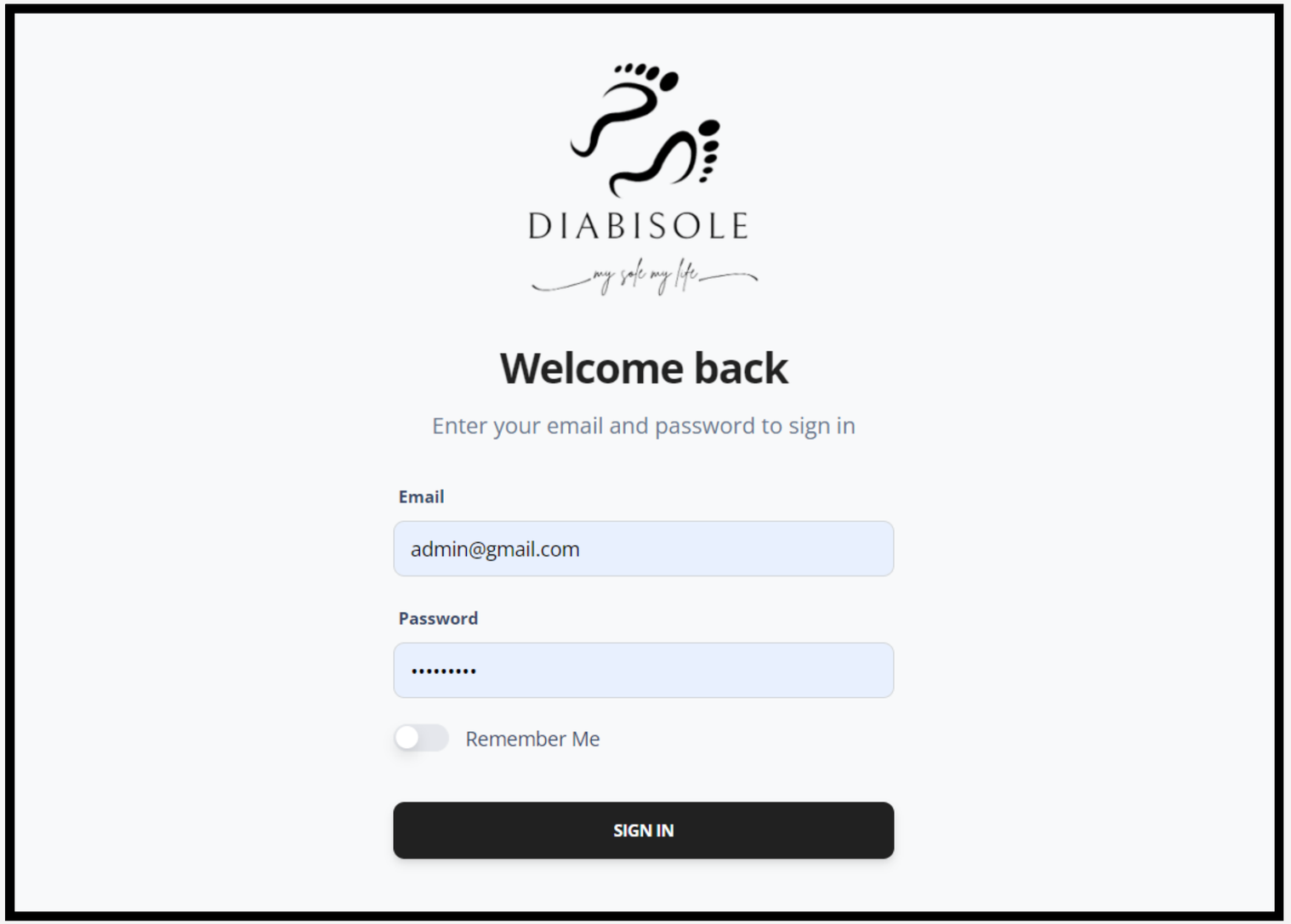
Dr. Piumika De Silva

Kings Hospital

Colombo 05



DEMONSTRATION



DIABISOLE

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Q & A

DIABISOLE

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THANK YOU