

Classifying Skin Diseases using Computer Vision

DSI37 Capstone Project
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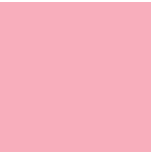
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01

Background



In Singapore, Atopic Dermatitis affects



20%
of children

and



11%
of adults





Acne affects up to

88% of adolescents¹

41% of adults²



50% affects the back and chest³

1. <https://www.singhealth.com.sg/patient-care/conditions-treatments/acne-vulgaris>
2. <https://www.straitstimes.com/life/style/breaking-out-adult-acne-is-more-common-than-you-think>
3. <https://pubmed.ncbi.nlm.nih.gov/18561586/>



Increased Demand for Skin Problems

Singapore

Tackling that itch: Demand for help with skin issues on the rise in Singapore

More awareness is part of the reason behind the increase, according to dermatologists.



A psoriasis patient with red welts on her skin. (File photo: Shivaanan Selvasevaran)

In **2016**, National Skin Centre had **304,000** outpatient clinic attendances, **up from 263,000 in 2008**.

~833 patients a day

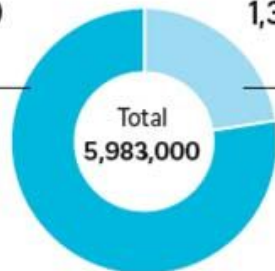
Healthcare Burden

ATTENDANCE AT SUBSIDISED PRIMARY CARE

2014

Polyclinics
4,648,000

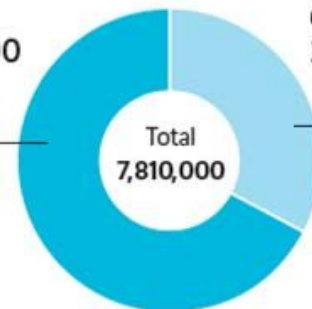
GP clinics (Chas*)
1,335,000



2016

Polyclinics
5,264,000

GP clinics (Chas*)
2,546,000



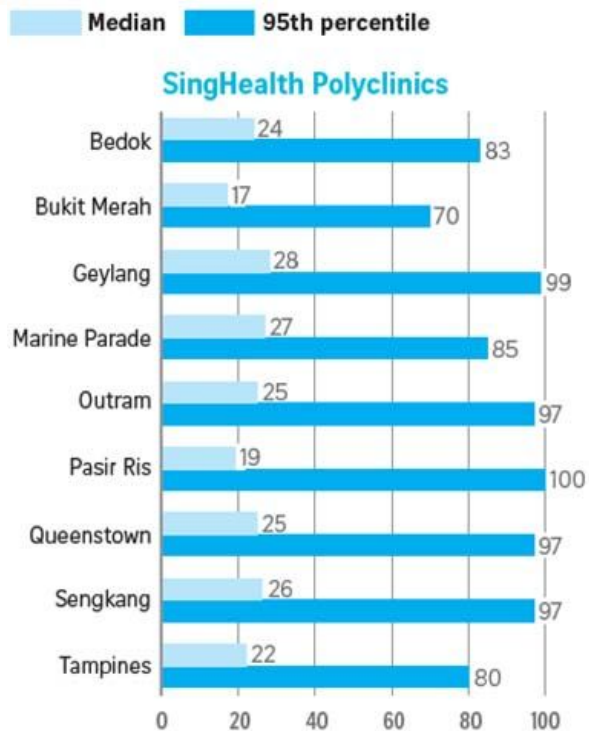
NOTE: *Community Health Assist Scheme

Source: MOH STRAITS TIMES GRAPHICS

30.5%
increase in 2 years

Long waits at clinics

WAIT TO SEE DOCTOR AFTER REGISTRATION (MINUTES)



1 in 20 patients

waited **70-100 minutes** to see a doctor

Not inclusive of

- Registration
- Collecting medicines
- Payment



Long waits at clinics

THE STRAITS TIMES

Forum: Long wait at polyclinic but still did not get to see doctor

UPDATED MAR 14, 2023, 5:34 AM SGT ▾



I wish to express my concern about the accessibility of public healthcare at polyclinics in Singapore.

Recently, I took my 19-year-old daughter who had a fever of 37.8 deg C to Bukit Batok Polyclinic and was told to queue for a time slot to see the doctor.

But we ended up not getting a time slot because my daughter was not considered a priority case, as she was neither a child nor an elderly person running a high fever.



Why target skin diseases?

Top 4 skin conditions in SG:

1. Eczema
2. Acne
3. Viral skin diseases
4. Fungal skin diseases

All
Self-Treatable
(For mild cases)



Acne

- Caused by bacteria, blockage of hair follicles, and others
- Many different types (e.g. blackheads, papules, pustules)



Blackheads



Papules

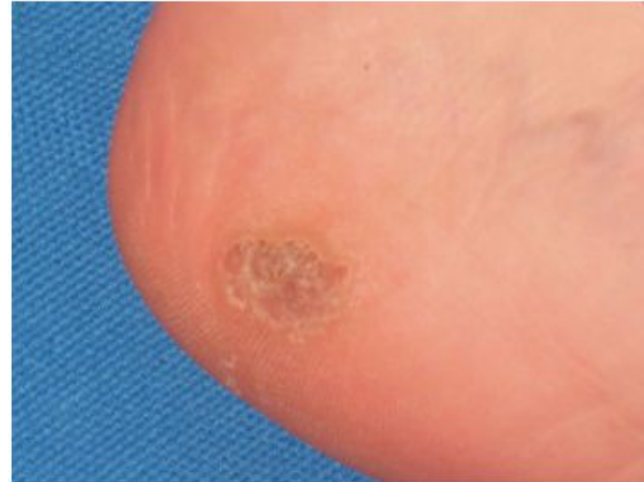


Warts

- Caused by viruses
- Affects up to 15% of children
- Many types (e.g. common, plantar, flat warts)



Common wart



Plantar wart



Eczema

- Most common inflammatory skin disease worldwide
- **Itchy, dry, bumpy skin rash**
- Presentation varies widely



Acute



Chronic



Fungal Skin Infections

- Commonly called ringworm/tinea
- **Red, circular, and clearly demarcated border**





Psoriasis

- Skin disease where skin cells grow too quickly
- Many types, but **plaque psoriasis is the most common**
- **Red, scaly, raised plaques**
- Needs to be treated and followed up by a dermatologist



Guttate



Chronic Plaque



Flexural

02

Problem Statement

- The aim of this project is to **develop an image classification model that accurately classifies common skin diseases** prevalent in Singapore.
- The model should assist individuals in obtaining a **preliminary diagnosis, empower them with information,** and allow them to **explore self-treatment options.**



Potential Benefits

Societal

Lower Healthcare
Burden



Increased
productivity



Free up resources

Individual

Enhanced
knowledge



Increased
Productivity



Reduced Cost



03 Data





Data Sources



Kaggle

- Downloaded 4 image categories
 - **Eczema**
 - **Warts**, Molluscum and other Viral Infections
 - **Psoriasis**, Lichen Planus and related diseases
 - **Tinea**, Ringworm, Candidiasis and other Fungal Infections
- Removed microscopic images
- Filtered by file names

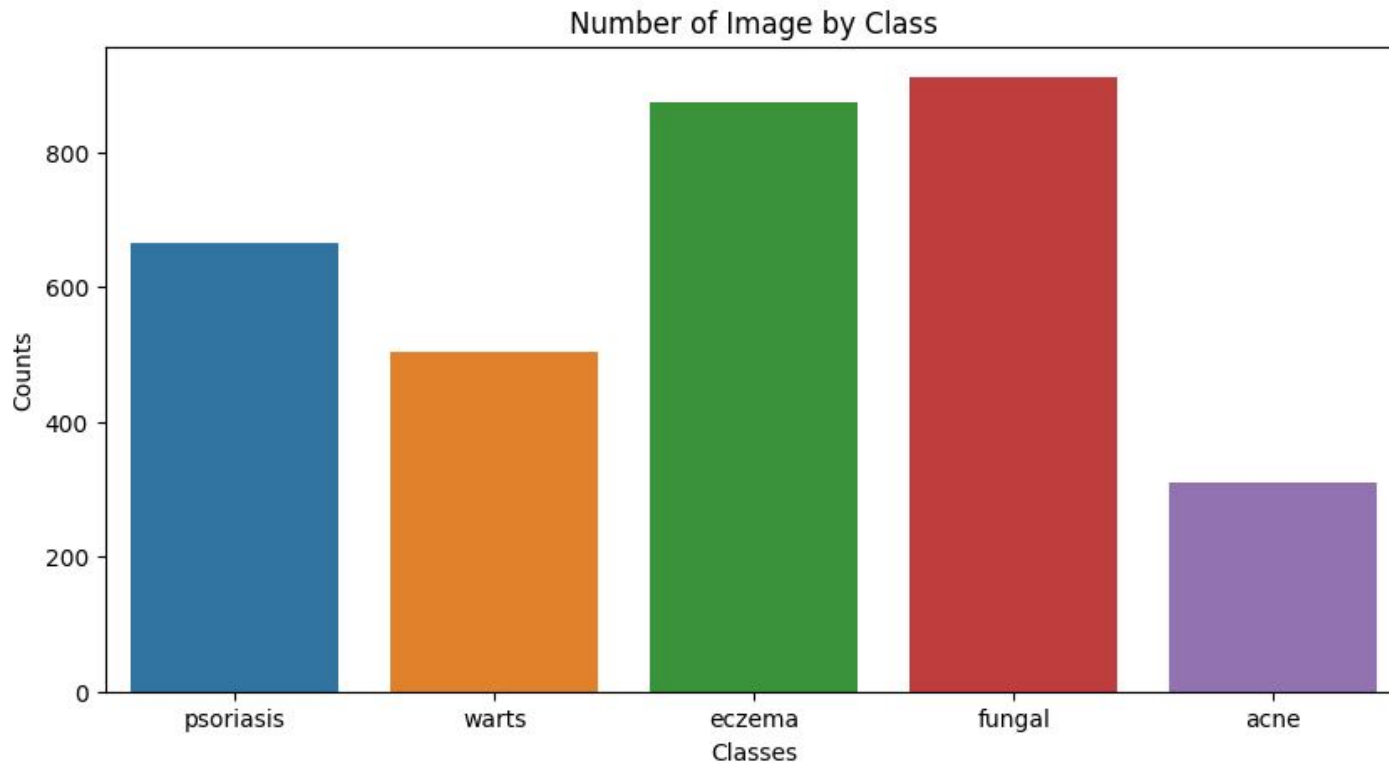


DermNet

- Scraped **acne** images



Class Balance



Total:
3265 images



Example Images

psoriasis



psoriasis



warts



warts



eczema



eczema



fungal



fungal



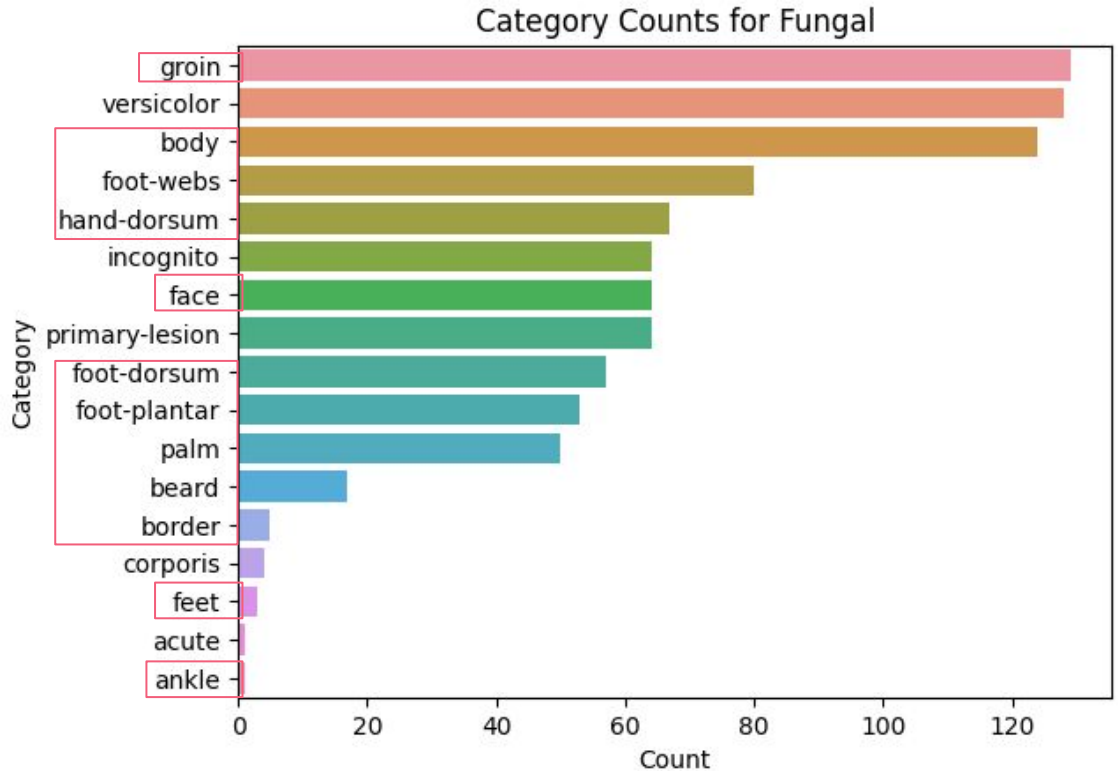
acne



acne



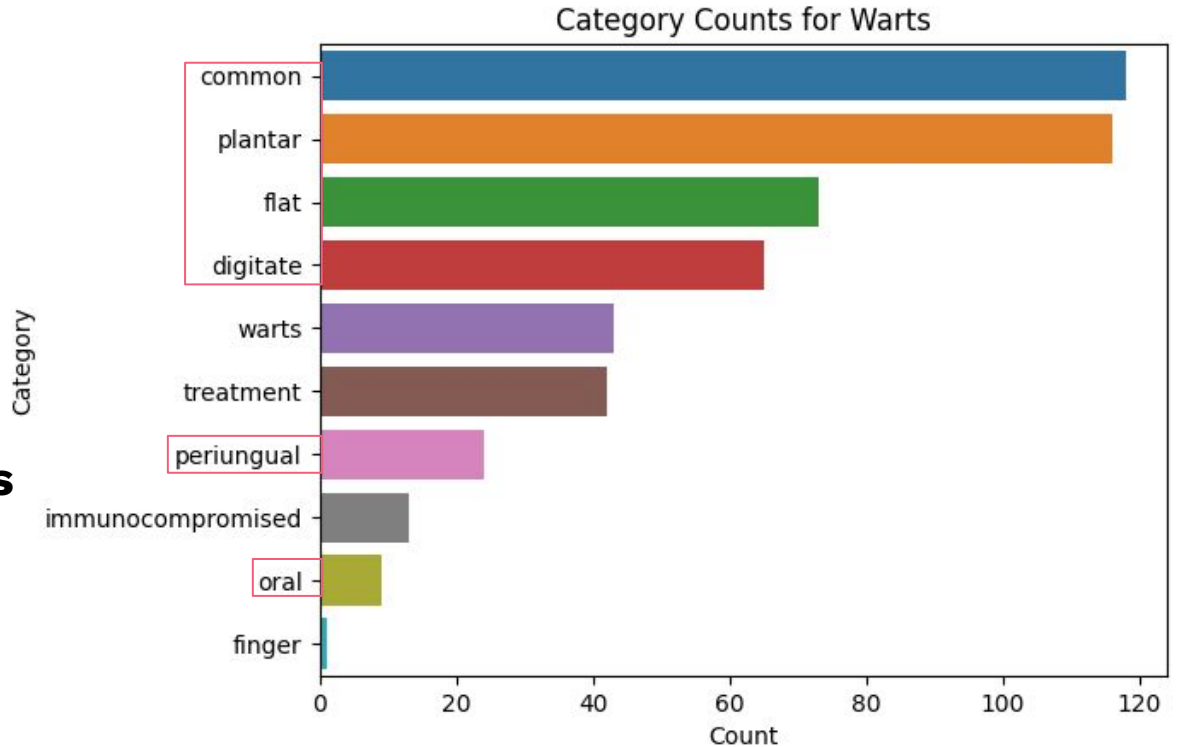
Subcategories for fungal infection



**Many body parts
affected**

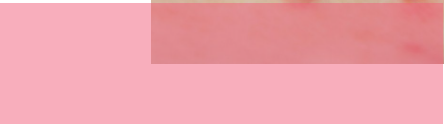
Subcategories for warts

**Warts appear
mainly on the
hands/fingers/feets**

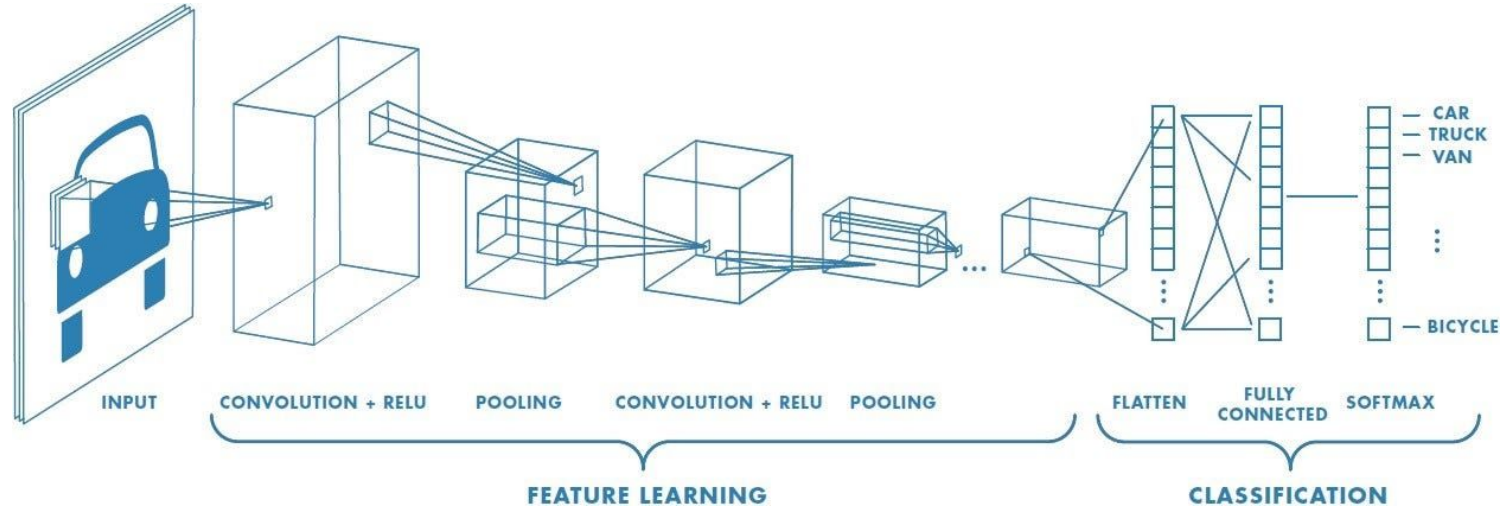




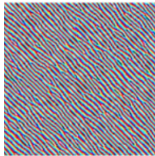
04 Model



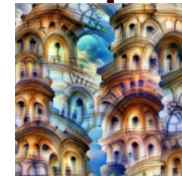
Convolutional Neural Networks



Simple



Complex

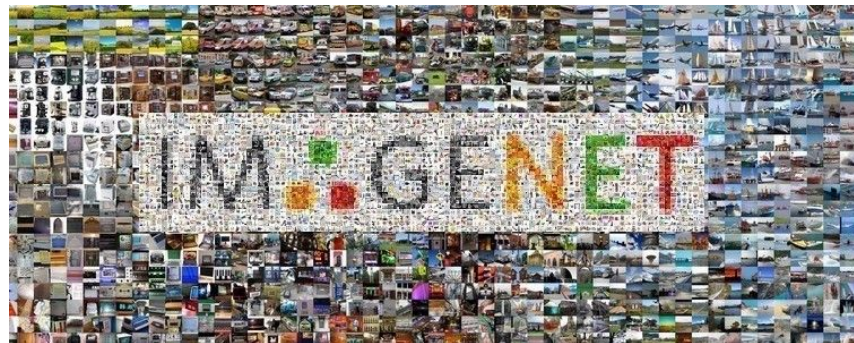




Transfer Learning

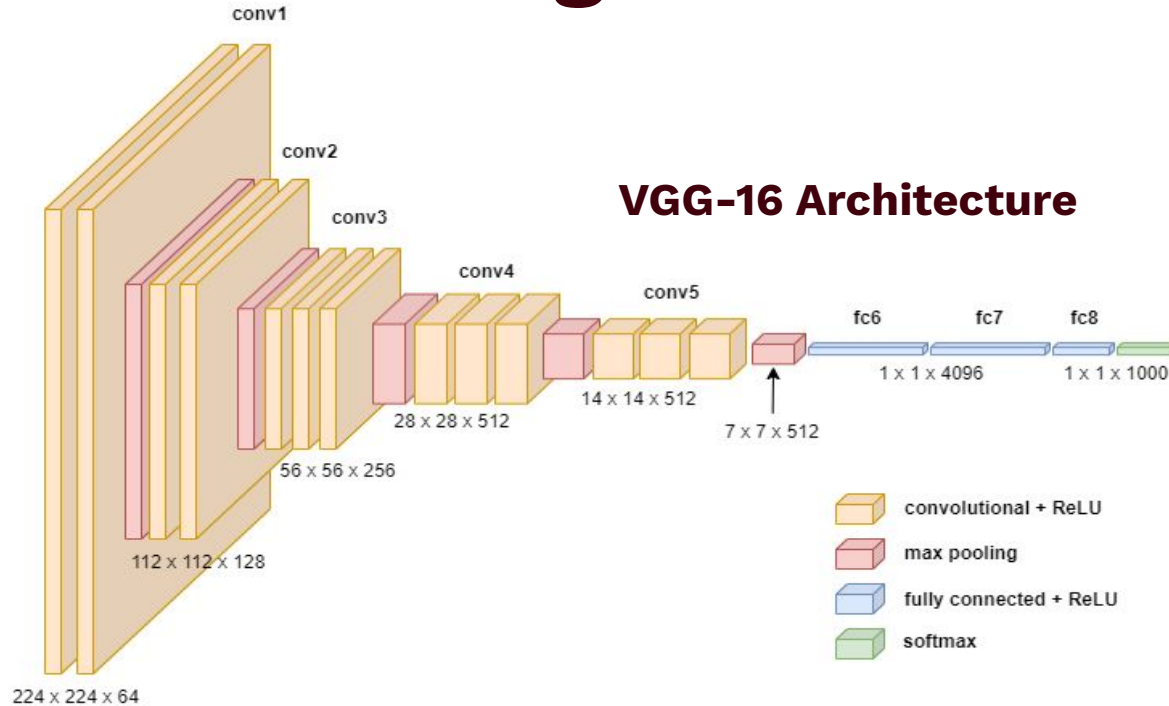
3 Pre-Trained Models:

1. **EfficientNetV2L**
2. **VGG16**
3. **ResNet152V2**



Trained on > 14 million images

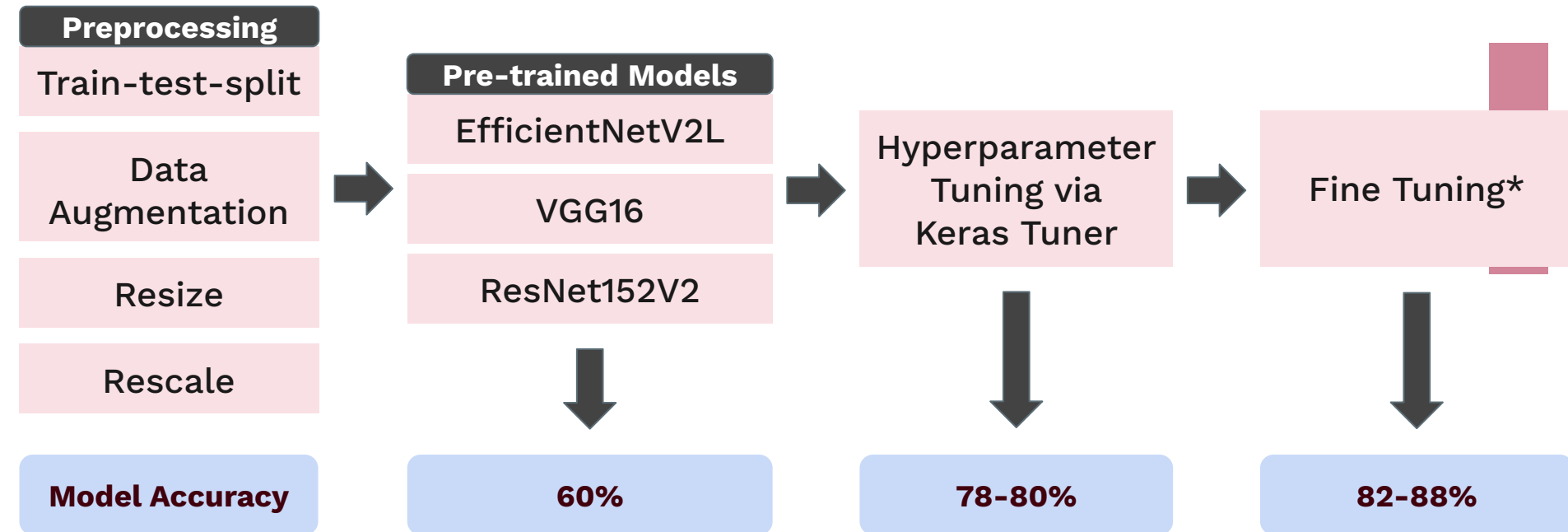
Transfer Learning



Freeze bottom layers for
extracting basic features

Modify top layers for
classification

Model Approach



* Fine tuning refers to unfreezing 1 or more pre-trained layers and training for a few epochs to increase the performance of a model



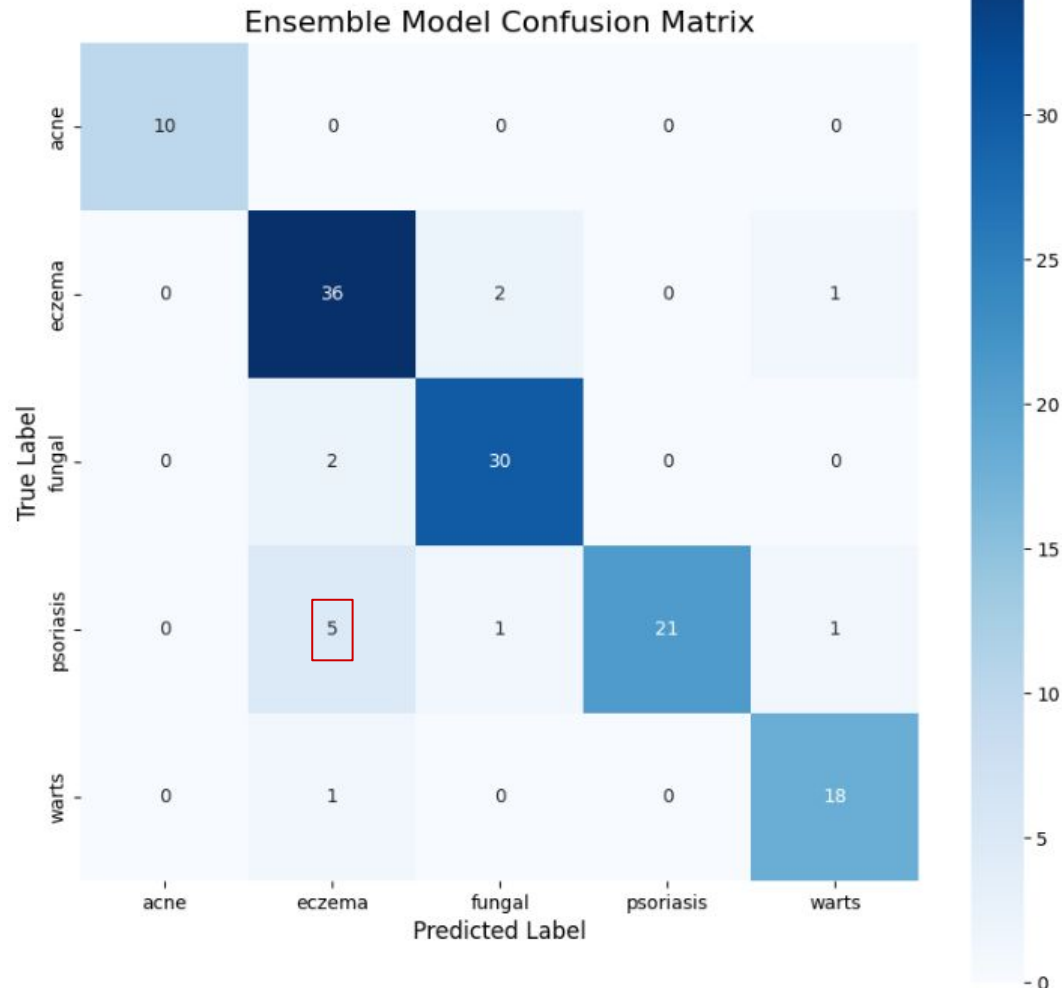
Model Summary

	Train Accuracy	Test Accuracy
EfficientNetV2L (Baseline)	0.88	0.78
EfficientNetV2L (Fine-tuned)	0.93	0.88 (↑ 12.8%)
ResNet152V2	0.91	0.80 (↑ 2.6%)
ResNet152V2 (Fine-tuned)	0.98	0.82 (↑ 5.1%)
VGG16	0.96	0.81 (↑ 3.8%)
VGG16 (Fine-tuned)	0.99	0.85 (↑ 9.0%)
Ensemble Model (Final)	0.99	0.90 (↑ 15.4%)

Ensemble model is made by combining the 3 fine-tuned models together




**Psoriasis is
commonly
misclassified
as eczema**



Skin Condition Predictor

 Predictor

 Condition

 Management

 Medications

Upload an image file for prediction



Drag and drop file here

Limit 200MB per file • JPG, PNG, JPEG

Browse files



0_32.jpg 19.8KB



You have successfully uploaded an image

Model Deployment



05 Insights



Highly accurate model

	precision	recall	f1-score	support
acne	1.00	1.00	1.00	10
eczema	0.82	0.92	0.87	39
funga1	0.91	0.94	0.92	32
psoriasis	1.00	0.75	0.86	28
warts	0.90	0.95	0.92	19
accuracy			0.90	128
macro avg	0.93	0.91	0.91	128
weighted avg	0.91	0.90	0.90	128

Some classes are more difficult to classify

Actual: eczema
Predicted: fungal



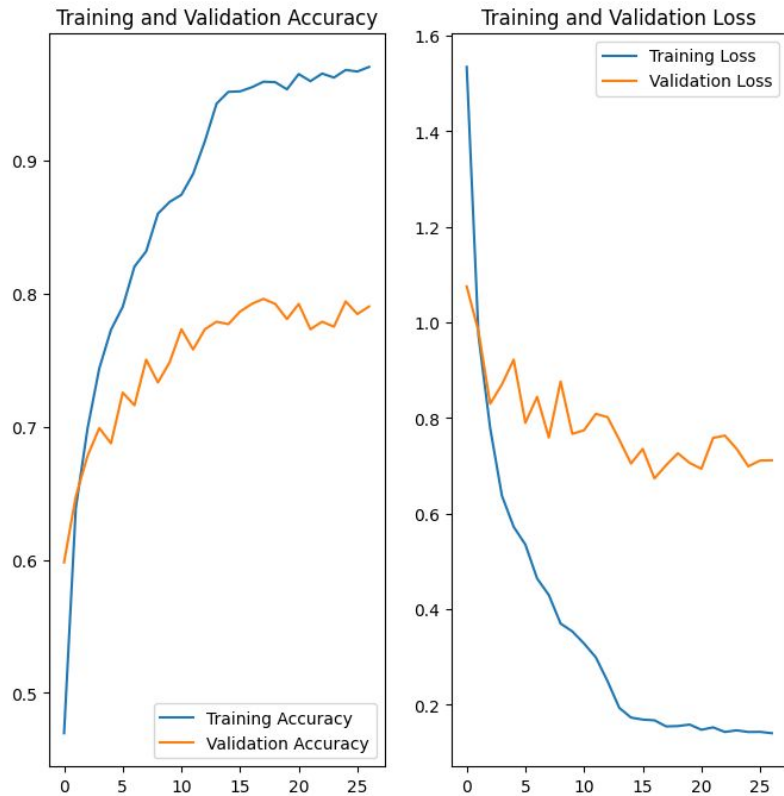
Actual: fungal
Predicted: eczema



Red, circular, clearly demarcated border
usually points
towards a fungal
infection

Challenges: Overfitting

VGG16



**Most models have
tendency to overfit**

Challenges: Overfitting

3 ways to reduce overfitting

- Dropouts
- Data augmentation
- Simplifying the model

All methods contributes to significant underfitting

	network	augment	GlobalPool	units_1	batch_norm	dropout	optim	lr	score
19	VGG	soft	NaN	1280	False	0.1	adam	0.000448	0.796191
7	VGG	soft	NaN	1280	False	0.1	sgd	0.001697	0.779048
18	VGG	soft	NaN	1280	True	0.1	sgd	0.000940	0.763810
9	VGG	soft	NaN	896	False	0.2	adam	0.001995	0.752381
10	VGG	soft	NaN	1152	True	0.4	adam	0.001027	0.740952
5	VGG	soft	NaN	640	True	0.1	sgd	0.004630	0.729524
8	VGG	soft	NaN	640	True	0.2	sgd	0.003298	0.706667
14	VGG	soft	NaN	256	False	0.3	adam	0.000148	0.706667
3	VGG	hard	NaN	128	False	0.1	adam	0.003880	0.615238
2	VGG	medium	NaN	1152	False	0.1	sgd	0.003507	0.615238
4	VGG	hard	NaN	384	False	0.5	adam	0.000630	0.611429
13	VGG	hard	NaN	896	False	0.1	sgd	0.002692	0.601905
12	VGG	medium	NaN	1280	False	0.5	sgd	0.004871	0.596190
17	VGG	medium	NaN	640	True	0.4	adam	0.000400	0.586667
0	VGG	hard	NaN	1152	False	0.3	sgd	0.000473	0.584762
1	VGG	medium	NaN	512	True	0.1	sgd	0.002948	0.582857
16	VGG	medium	NaN	640	True	0.5	sgd	0.001358	0.582857
11	VGG	medium	NaN	640	True	0.2	adam	0.002565	0.577143
15	VGG	hard	NaN	768	False	0.5	sgd	0.000897	0.571429
6	VGG	hard	NaN	768	True	0.5	adam	0.003091	0.565714



06

Recommendations



Skin Condition Predictor

Predictor

Condition

Upload an image file for prediction

Drag and drop file here

Limit 200MB per file • JPG, PNG, JPEG

Prediction

One-stop
Solution

Management



Symptoms

Acne may present with varying degrees of severity (least to most severe):

- Whiteheads (closed plugged pores)
- Blackheads (open plugged pores)
- Small red, tender bumps (papules)
- Pustules (pimples with pus at the tip)
- Large, solid, painful lumps under the skin (nodules)
- Painful, pus-filled lumps under the skin (cystic lesions)



Whiteheads



Blackheads



Papule

Disease
Information

Over-the-counter Medicines

These medicines can be bought off the shelf at retail pharmacies such as Guardian, Watsons, Unihy, and certain hospitals.

Benzoyl Peroxide

Pharmacy-only Medicines

These medicines can be bought from retail/hospital pharmacies provided there are pharmacists available.

Topical Retinoids

TLDR: Which medicines should I choose?

- In general, adapalene is more effective than benzoyl peroxide, but benzoyl peroxide is more readily available.
- If you only have a few pimples and you are not very bothered by it, benzoyl peroxide may be sufficient.
- Otherwise, adapalene is always a good choice.



Integration with Telemedicine

**Video
Consult**

**Medication
Delivery**

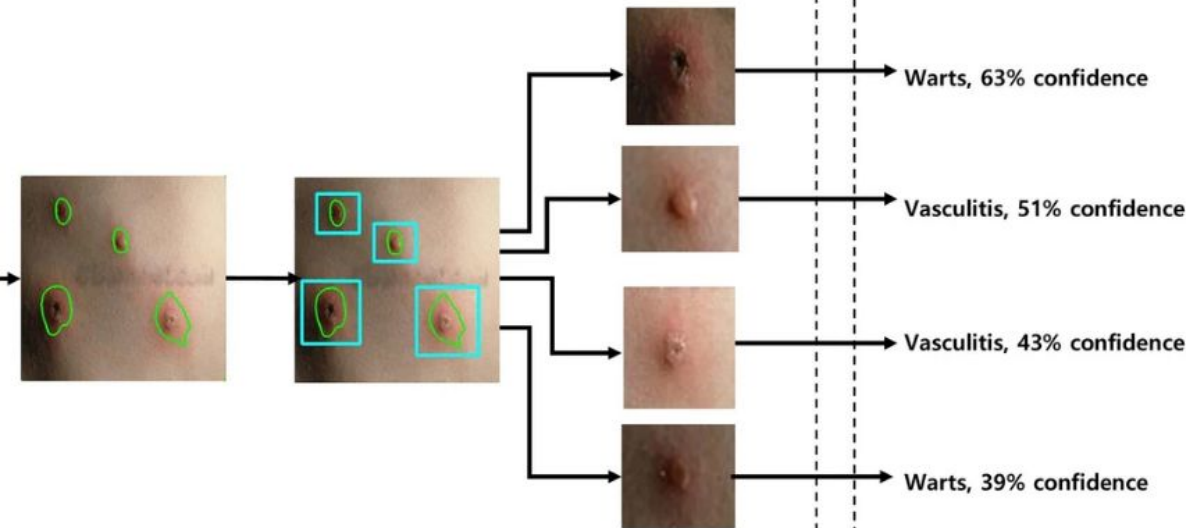
TeleConsult

Your guide to your next clinic appointment, wherever you are



Step I: Segmentation

Step II: Classification



**Improving the
model by
introducing
segmentation**

Current Options

Polyclinic



Reduced cost



Long waiting time



Little information

GP Clinic



Expensive



Shorter waiting time



Little information

Updated Options

Polyclinic



Reduced cost



Long waiting time



Little information

GP Clinic



Expensive



Shorter waiting time



Little information

Model



Reduced cost



No wait needed



All the information
you need

Thanks!

Do you have any questions?



<https://www.linkedin.com/in/enoch-loy/>



<https://github.com/enochloy>

